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Human Health And Ecological Baseline Risk Assessment Terminal 1 South 2100 NW Front Avenue Portland, Oregon

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Prepared for
Port of Portland

Port Project No. 24232
Port Task No. 730

January 18, 2002
15191-01

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Human Health And Ecological Baseline Risk Assessment
Terminal 1 South
2100 NW Front Avenue
Portland, Oregon

Boston

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Eureka

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Jersey City

Prepared by
Hart Crowser, Inc.

Juneau

for **Neil F. Morton**
Project Toxicologist

Taku Fuji, Ph. D.
Associate Toxicologist

Long Beach

Portland

Seattle

Hart Crowser, Inc.
Five Centerpointe Drive, Suite 240
Lake Oswego, Oregon 97035-8652
Fax 503.620.6918
Tel 503.620.7284

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ACRONYMS

BW	Body Weight
CDI	Chronic Daily Intake
COPC	Chemicals of Potential Concern
CSM	Conceptual Site Model
CT	Central Tendency
DEQ	Oregon Department of Environmental Quality
EDI	Estimated Daily Intake
EPA	United States Environmental Protection Agency
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
HEAST	Health Effects Assessment Summary Table
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IRIS	Integrated Risk Information System
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NOAEL	No Observed Adverse Effect Level
OAR	Oregon Administrative Rules
ONHP	Oregon Natural Heritage Program
PAH	Polycyclic Aromatic Hydrocarbon
PORT	Port of Portland
PRG	Preliminary Remediation Goal
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
SF	Slope Factor
SQL	Sample Quantitation Limit
T&E	Threatened and Endangered
T1S Site	Terminal 1 South Site
TPH	Total Petroleum Hydrocarbon
UCL	Upper Confidence Limit
UF	Uncertainty Factor
VOC	Volatile Organic Compound

HUMAN HEALTH AND ECOLOGICAL BASELINE RISK ASSESSMENT
TERMINAL 1 SOUTH
2100 NW FRONT AVENUE
PORTLAND, OREGON

EXECUTIVE SUMMARY

Objectives. Hart Crowser conducted a human health risk assessment (HHRA) and a Level 1 Scoping and a Modified Level 2 Screening ecological risk assessment (ERA) for the Port of Portland Terminal 1 South (T1S Site) in Portland, Oregon. The purpose of the HHRA is to evaluate potential risks and hazards to human health associated with each potential exposure pathway (complete pathways identified for the site are exposure to surface and subsurface soil and inhalation of volatile compounds from groundwater). The purpose of the Level 1 Scoping ERA is to provide a conservative, qualitative determination of whether ecological receptors and/or exposure pathways are potentially present at or in the locality of the site. The Modified Level 2 Screening ERA was conducted on site groundwater data to determine whether constituents were present at levels of concern for aquatic ecological receptors.

Site Description and History. The T1S Site is located at 2100 NW Front Avenue in Portland, Oregon (Figure 1). The site consists of approximately 21 acres that are almost completely paved with asphalt or concrete or covered by buildings (Figure 2). Two primary structures, designated as Warehouse No. 2 and House No. 104, are currently located at the T1S Site. An extensive dock structure is present over submerged lands at Berths 104, 105, and 106.

Historically, Terminal 1 has been used for the staging of lumber, logs, paper products, steel containers, and bagged grain. Various companies have owned or leased portions of the Terminal 1 South Complex (see Remedial Investigation [RI] Report; Hahn and Associates, 2001a). The T1S Site will be redeveloped for residential and commercial purposes. Potentially exposed populations that were evaluated in the HHRA include future residents, current and future commercial workers, and future utility/excavation workers. The site was divided into three Areas of Concern (AOC) and separate risk calculations and risk estimates were conducted for each area. The areas are presented on Figure 2.

Human Health Risk Assessment Results for Area A. The assessment of carcinogenic risks to residential receptors at Area A indicated that under both Reasonable Maximum Exposure (RME) and Central Tendency (CT) conditions, the potential risks exceeded DEQ acceptable risk levels. Compounds of Potential Concern (COPCs) that exceeded the Department of Environmental

Quality (DEQ) acceptable risk level for individual carcinogens are benzo(a)pyrene, benzo(a)anthracene, dibenz(a,h)anthracene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene and arsenic. The assessment of noncarcinogenic risks identified only lead as present above acceptable risk levels for residential exposure under both RME and CT conditions.

For the commercial worker exposure scenario, the estimated cumulative carcinogenic risks were found to be acceptable under both RME and CT conditions. However, benzo(a)pyrene and arsenic exceeded the DEQ acceptable risk level for individual carcinogens. The assessment of noncarcinogenic risks identified lead as present above the acceptable risk level for commercial worker exposure under only the RME condition.

For the excavation worker exposure scenario, no unacceptable risks from exposure to carcinogens were identified. The assessment of noncarcinogenic risks identified lead as present above the acceptable risk level for excavation worker exposure under only the RME condition.

As discussed in the report, the RME and CT exposure point concentrations (EPCs) for lead in surface and total soil in Area A are driven by the maximum detection in one sample (B-68). If this sample were removed from the data set, the lead EPCs would be acceptable for the residential and commercial receptors. Additionally, while arsenic was identified as a carcinogen resulting in unacceptable risks in Area A, there were only two soil samples (within the 0 to 15 feet depth ranges evaluated in this HHRA) that exceeded the site-specific background level of 5.3 mg/kg identified in the RI (Hahn and Associates, 2001a).

Human Health Risk Assessment Results for Area B. The assessment of carcinogenic risks to residential receptors at Area B indicated that potential risks exceeded DEQ acceptable risk level only under the RME condition. COPCs that exceed the DEQ acceptable risk level for individual carcinogens are benzo(a)pyrene and arsenic. The assessment of noncarcinogenic risks found no exceedences of DEQ acceptable risk levels for residential exposure.

For the commercial worker exposure scenario, the estimated cumulative carcinogenic risks were found to be acceptable under both RME and CT conditions. However, arsenic exceeded the DEQ acceptable risk level for individual carcinogens under the RME condition. The assessment of noncarcinogenic risks found no exceedences of DEQ acceptable risk levels for commercial worker exposure.

No unacceptable carcinogenic or noncarcinogenic risks were estimated for the excavation worker exposure in Area B.

Arsenic was identified as a carcinogen resulting in unacceptable risks in Area B for residential and commercial worker exposure scenarios. However, there were no detected concentrations of arsenic in soils in Area B that exceeded the site specific background level of 5.3 mg/kg identified in the RI (Hahn and Associates, 2001a).

Human Health Risk Assessment Results for Area C. The cumulative RME and CT carcinogenic risks for all potential receptors (resident, commercial worker, and excavation worker) in Area C were found to be acceptable with the exception of the RME residential scenario. Arsenic exceeded DEQ individual carcinogen acceptable risk level for the RME residential and commercial worker scenarios. The assessment of noncarcinogenic risks found no exceedences of DEQ acceptable risk levels for all potential receptors. There were no detected concentrations of arsenic in surface soils in Area C that exceeded the site specific background level of 5.3 mg/kg identified in the RI (Hahn and Associates, 2001a).

Ecological Risk Assessment Results. The Level 1 Scoping ERA did not identify any ecologically important species or habitats at the T1S Site. The site is almost entirely paved or covered by buildings. The absence of upland habitat indicates that there are no complete exposure pathways for terrestrial ecological receptors to come in contact with contaminated soil at the T1S Site.

A Modified Level 2 Screening ERA was conducted on the available groundwater monitoring well data collected at this site. There were no detected concentrations of organic constituents in the seven groundwater monitoring wells that exceeded their corresponding Ecological Screening Benchmark Values (SBVs). There were two metals (copper and lead) detected in groundwater that exceeded SBVs based on the analysis of unfiltered, total metals, but when the same samples were analyzed for dissolved metals, copper and lead were not detected. The dissolved fraction of metals represents the bioavailable fraction in aqueous environmental media. Therefore, it is concluded that there is no potential for adverse ecological impacts to aquatic ecological receptors from the discharge of groundwater to the Willamette River. No additional ecological risk assessment activities are warranted at this site.

1.0 INTRODUCTION AND PURPOSE

This report summarizes the results of the human health risk assessment (HHRA) and Level 1 Scoping and Modified Level 2 Screening ecological risk assessment (ERA) performed at and in the vicinity of the Port of Portland (Port) Terminal 1

South (T1S Site) in Portland, Oregon. This report was prepared for the Port, Project Number 24232 and Task Number 730. The purpose of the HHRA is to evaluate current and predicted future site conditions and to assess if these conditions pose unacceptable risks to public health. The purpose of the Level 1 Scoping ERA is to provide a conservative, qualitative determination of whether ecological receptors and/or exposure pathways are potentially present at or in the locality of the site. The Modified Level 2 Screening ERA was conducted on site groundwater data to determine whether constituents were present at levels of concern for aquatic ecological receptors.

The HHRA was conducted in accordance with the protocol for performing risk assessments under Oregon Administrative Rules (OAR) 340-122-084 and the Department of Environmental Quality's (DEQ's) Guidance for Conduct of Deterministic Human Health Risk Assessments (DEQ, 2000). Additionally, the scope of this risk assessment was further defined based on the Risk Assessment Work Plan (Hart Crowser, 2001), DEQ Comments on the Risk Assessment Work Plan (letter dated October 25, 2001), and Port of Portland's Response to Review Comments (letter dated November 12, 2001). The Level 1 - Scoping ERA was completed in accordance with the *Guidance for Ecological Risk Assessment* (DEQ, 1998) and the Modified Level 2 Screening ERA was completed in accordance with the methodology presented in the Risk Assessment Work Plan and further discussed with DEQ in the Port of Portland's Response to Review Comments Letter.

This report is organized as follows:

- Section 2.0 - Site Location and History
- Section 3.0 - Human Health Risk Assessment
- Section 4.0 - Level 1 Scoping Ecological Risk Assessment
- Section 5.0 - Limitations
- Section 6.0 - References

2.0 SITE LOCATION AND HISTORY

This section summarizes the available information on this site. A more detailed description of environmental activities and the results of the remedial investigation (RI) conducted at this site are provided in the Terminal 1 South Remedial Investigation Report (Volumes 1 and 2) prepared by Hahn and Associates (Hahn and Associates, 2001a).

2.1 Site Location and Description

2.1.1 Site Location

The T1S Site is located at 2100 NW Front Avenue along the Willamette River in Portland, Oregon (Figure 1). The site consists of approximately 21 acres located northwest of Interstate 405 (Fremont Bridge), northeast of NW Front Avenue, southeast of Slip No. 2, and southwest of the Willamette River (Figures 1 and 2). The T1S Site does not include sediments adjacent to the Site.

2.1.2 Site Description

Two primary structures, designated as Warehouse No. 2 and House No. 104, are currently located at the T1S Site. Tristar Transload currently leases and operates the open storage area southeast of Slip No. 2 and northwest of House No. 104 and portions of House No. 104. The remaining portions of the site are unoccupied. Additionally, an extensive dock structure is present over submerged land at Berths 104, 105, and 106.

The topography at the T1S Site is generally level at an elevation of approximately 30 feet above mean sea level (msl). The site is generally paved with asphalt or concrete with little or no vegetation or bare ground present.

2.1.3 Site History

The site history presented here is summarized from information contained in a Preliminary Assessment (PA) (Port of Portland, 2000) prepared for the T1S Site. In approximately 1884, upland areas in the vicinity of Terminal 1 extended 100 to 200 feet northeast of Front Avenue. By 1908, they extended approximately 200 to 400 feet northeast of NW Front Avenue. Since that time, various portions of the T1S Site have been filled and dredged. Slip Nos. 1 and 2 were created by dredging in approximately 1914 and 1923, respectively. Filling activities at the site were generally completed in approximately 1972 when Slip No. 1 was filled.

Between 1913 and 1936, the Commission of Public Docks purchased various parcels of property in four primary phases. Three of these parcels now make up the Marine Terminal 1 South complex. The Commission of Public Docks merged into the Port on January 1, 1971.

Prior to and during World War II, Terminal 1 and the adjacent industrial neighborhood supported expanded activities on behalf of the war effort. Ship

building and repair at the Willamette Iron and Steel facility formerly located at Terminal 1 necessitated increased dock front dredging (for larger ship berths) and the occasional use of Terminal 1 property for temporary equipment storage.

In 1946, the Commission of Public Docks (CPD) purchased the Eastern and Western Lumber Company property to the immediate north of Terminal 1 South. Willamette Iron & Steel Corporation, now adjacent to the CPD terminal, changed ownership in the same year, becoming the Willamette Iron and Steel Company.

Historically, Terminal 1 has been used for the staging of lumber, logs, paper products, steel containers, and bagged grain. Various companies have owned or leased portions of the Terminal 1 South Complex (see RI Report; Hahn and Associates, 2001a). The T1S Site will be redeveloped for residential and commercial purposes.

2.2 *Site Geology and Hydrogeology*

This section presents a summary of the site geology and hydrogeology. Additional details of site geology and hydrogeology are presented in the RI Report (Hahn and Associates, 2001a) and the Monitoring Well Installation and Groundwater Sampling Report (Hahn and Associates, 2001b).

2.2.1 Geology

- The subsurface soils encountered during the investigations were predominantly sands and silts with occasional gravel to the maximum depth of investigation at 80 feet below ground surface (bgs).
- Based on historical documentation and investigations, the property has been extensively filled in through time; fill material was encountered at all push-probe locations from the surface to depths of 32 to 67 feet bgs.
- Soils thought to be former Willamette River sediments were encountered at the former Slip No. 1 (B-84) at a depth of approximately 67 feet bgs.
- Soils encountered beneath NW Front Avenue were generally siltier than those encountered on the T1S Site, suggesting the soils in the right of way are either alluvial in origin or from a different fill source than that of the site.

2.2.2 Hydrogeology

- Groundwater in the vicinity of the T1S Site generally occurs in three principal hydrogeologic zones: (1) a shallow unconfined fill/alluvial deposit (shallow water-bearing zone [WBZ]); (2) generally confined Troutdale WBZ;

and (3) the confined Columbia River Basalt WBZ.

- Unconfined groundwater was encountered within the shallow WBZ (fill) at an average depth of approximately 23 feet bgs.
- Groundwater elevation measured in the seven monitoring wells installed at the T1S Site on September 28 and October 30, 2001 indicate a general flow to the northeast towards the Willamette River with a decline or even reversal of the gradient near the river (Hahn and Associates, 2001b).

2.3 Previous Site Investigations

In July 2001, Hahn and Associates completed an RI at the T1S Site (Hahn and Associates, 2001a). RI activities completed at this site consisted of the following five phases:

- Focused Environmental Site Assessment completed by Maul Foster in 1998 (Maul Foster, 1998);
- Environmental Baseline Investigation completed by Hahn and Associates in February and March, 2000 (Hahn and Associates 2001a);
- B-38 Area Characterization completed by Hahn and Associates in March 2000 (Hahn and Associates 2001a);
- Supplemental Site Characterization Activities completed by Hahn and Associates in September 2000 (Hahn and Associates 2001a); and
- Data Gap Investigation completed by Hahn and Associates during October and November 2000 (Hahn and Associates 2001a).

A total of 112 push-probe borings were installed for the collection of soil and groundwater samples during these site activities. The locations of these push-probe borings are presented on Figure 2. Please refer to the RI Report (Hahn and Associates, 2001a) for further discussion of these activities and results.

A groundwater investigation was conducted at the T1S Site by Hahn and Associates in August, September, and October 2001 (Hahn and Associates 2001b). Site activities included installation, development, and sampling of seven groundwater monitoring wells at the site. The locations of the groundwater monitoring wells are presented on Figure 2. Please refer to the groundwater sampling report for further discussion of these activities and results (Hahn and Associates, 2001b).

2.4 Beneficial Land and Water Use Surveys

Beneficial land and water use determinations were completed at the T1S Site to identify current and reasonably likely future uses of land and water in the vicinity of the Site. This information was presented in the RI Report (Hahn and Associates, 2001a) and used to ensure that appropriate exposure scenarios were selected for evaluation in the proposed RA.

2.4.1 Locality of the Facility

The locality of the facility (LOF) is defined as "any point where a human or ecological receptor contacts, or is reasonably likely to come into contact with, facility related hazardous substances."

Chemicals have been detected in both soil and groundwater at various areas of the site, but off-site migration of contamination is not evident based on the existing data. Accordingly, the LOF is defined only as the T1S Site and the adjacent area on Front Avenue in Area A (Figure 2).

2.4.2 Land Use

Historical Land Use. The approximate 21-acre T1S Site has historically been zoned as "IH" for Heavy Industrial. Surrounding adjacent properties are zoned "IH" Heavy Industrial and "EX" Central Employment.

Current and Reasonably Likely Future Land Use. The current and reasonably likely future land use in the LOF is well defined. The site is currently zoned as Central Residential (RX) such that it can be redeveloped for an alternative use. The RX zoning is considered the comprehensive plan for the property. Based on the RX zoning designation, it is expected the site will be used for mixed-use residential/commercial development in the future.

2.4.3 Groundwater Beneficial Use

A beneficial groundwater use evaluation was conducted for the Hoyt Street Property (RETEC, 1997) that adjoins the southeast corner of the T1S Site. Hahn and Associates conducted an additional well inventory as part of the RI and the groundwater monitoring study to supplement the RETEC survey. Based on trends in groundwater use in the area as well as RETEC fate and transport modeling, the only identified beneficial use for groundwater in the LOF is discharge to the Willamette River. No water wells were found to be in use within one-half mile of the T1S Site. No surface water rights were identified within one-half mile of the T1S Site.

2.5 Chemical Data Quality Review

Prior to identifying Compounds of Potential Concern (COPCs) for the T1S Site, a chemical data quality review was conducted on the available soil and water analytical data collected as part of the RI completed at this site (Hahn and Associates, 2001a and 2001b). The following criteria were evaluated in the data quality review process:

- Holding times;
- Method blanks;
- Surrogate recoveries;
- Laboratory control sample/laboratory control sample duplicate (LCS/LCSD) recoveries;
- Matrix spike/matrix spike duplicate (MS/MSD) recoveries; and
- Laboratory and field duplicate relative percent difference (RPD).

The results of this data quality review are presented in Appendix F. Only those data of sufficient quality for use in the risk assessment were carried forward for COPC screening and risk calculations. The data that did not meet data quality objectives were rejected because quality assurance samples were not run concurrently with site samples. The exclusion of this data had no effect on the objectives of this risk assessment. The data that were rejected based on data quality concerns are discussed below:

- **Diesel and Oil.** Nine diesel/oil sample results from the Area A data set were rejected. However, only five of these samples were from the depth profile of 0 to 15 feet bgs that was considered in the risk assessment. Fifty-three diesel/oil samples were included in the Area A risk assessment data set. Eight diesel/oil sample results from the Area B data set were rejected (six in surface soil and two in subsurface soil), while 30 diesel/oil samples were included in the Area B risk assessment data set. All diesel and oil sample results from the Area B rejected samples were either low level or nondetect.
- **BTEX.** Six BTEX sample results from the Area A data set were rejected based on data quality concerns. All of the BTEX results from the rejected samples and from the samples that were not rejected were nondetect. In addition, all VOC samples collected at Area A were nondetect for BTEX.
- **PAHs.** Two PAH sample results from the Area A data set were rejected (one within the 0 to 15 feet depth profile), while 41 PAH samples were included in the risk assessment data set.

- **PCBs.** One PCB sample result from the Area A data set was rejected based on data quality concerns (sample B-38 collected at 10 feet bgs). The PCB sample results for this sample were nondetect.

2.6 Identification of Compounds of Potential Concern

Chemical analyses on samples collected at the T1S Site have identified diesel and oil as the fuel types present. However, due to the current lack of toxicity data for diesel or oil as a whole (each fuel type is a complex mixture of hundreds of chemical compounds), these fuels were not quantitatively evaluated in the HHRA. Instead, we focused on individual petroleum constituents within these fuel types for which appropriate toxicity data are available.

Specific chemical constituents of these fuel types are possible compounds of interest (COI). COIs are defined as compounds detected at the site, and COPCs are those COIs that exceed the risk-based screening levels as discussed below and are carried forward in the HHRA. Based on investigations conducted at the T1S Site, the COIs in soil and groundwater include the following groups of compounds: Total Petroleum Hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), and metals.

Evaluation for COPCs. In accordance with DEQ human health risk assessment guidance (DEQ, 2000), soil COIs were conservatively screened against EPA Region 9 Residential Soil Preliminary Remediation Goals (PRGs), and groundwater COIs were conservatively screened against EPA Region 9 Tap Water PRGs (EPA, 2000a). Because exposure to groundwater is limited to inhalation of VOCs that have migrated from groundwater to indoor or outdoor air, only VOCs detected in groundwater were evaluated as potential COPCs.

Additional steps, which are described in Section 2.3.2, (3)(a) through (e) of the DEQ human health risk assessment guidance, were also performed to ensure potential cumulative effects from multiple compounds or from an individual compound detected in multiple media were accounted for.

As presented in the Risk Assessment Work Plan for this site (Hart Crowser, 2001), the site was divided into three separate Areas of Concern (AOC). The AOCs are presented in Figure 2. COPCs were identified for each area and separate risk calculations and risk estimates were conducted for each area.

Tables 1 through 3 summarize the identification of COPCs in soil and groundwater for Areas A, B, and C, respectively. The following COPCs were identified in each area:

Area A

- Soil: Diesel, oil, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, arsenic, and lead. No soil PRGs are available for diesel and heavy oil; however, since both analytes were detected in soil they were retained as COPCs.
- Groundwater: Diesel and tetrachloroethene. Diesel was identified as a COPC because a tap water PRG is not available. Heavy oil was not detected in groundwater.

Area B

- Soil: Diesel, oil, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and arsenic. Diesel and oil were identified as COPCs because soil PRGs are not available.
- Groundwater: Diesel. Diesel was identified as a COPC because a tap water PRG is not available. Heavy oil was not detected in groundwater. Tetrachloroethene was not identified as a COPC for Area B since it was only detected in Monitoring Well 1, which is located in Area A.

Area C

- Soil: Arsenic.
- Groundwater: None.

3.0 HUMAN HEALTH RISK ASSESSMENT

This section describes the scope, focus, and approach for the HHRA for the site. This risk assessment conforms to the protocol for performing risk assessments under OAR 340-122-084 and DEQ's Guidance for Conduct of Deterministic Human Health Risk Assessments (DEQ, 2000). Other guidance were used as appropriate and where indicated. The HHRA evaluates the probability and magnitude of adverse impacts on human health associated with actual or potential exposure to site-related COPCs. This information was used to determine what additional remedial actions are needed (if any) to mitigate any predicted impacts. Deterministic human health risk assessments for both existing and reasonably likely future exposure scenarios were performed.

In accordance with EPA and DEQ guidance, the risk assessment consists of the

following four phases: Exposure Assessment, Toxicity Assessment, Risk Characterization, and Uncertainty Analysis. In the exposure assessment, potentially exposed populations and potentially complete exposure pathways (shown in the human health conceptual site model [CSM], Figure 3) were identified based on current and future land use scenarios. Exposure point concentrations (EPC) and reasonable maximum exposure (RME) and central tendency (CT) intake rates were calculated for each complete exposure pathway based on the use of exposure factors that reflect site-specific conditions.

In the toxicity assessment, quantitative toxicity information was collected, and appropriate toxicity values were determined for use in quantifying carcinogenic and non-carcinogenic risks associated with exposure to site-related chemicals. In the risk characterization phase, the results of the exposure assessment and toxicity assessment were combined to estimate the potential cancer risks and non-cancer hazard quotients at the site. In the uncertainty section, the uncertainty associated with the exposure assessment, toxicity assessment, and risk characterization sections are discussed.

3.1 Exposure Assessment

The objectives of an exposure assessment are to:

- Identify potentially exposed populations;
- Identify potentially complete exposure pathways; and
- Measure or estimate the magnitude, duration, and frequency of exposure for each receptor (or receptor group).

3.1.2 Final Conceptual Site Model

The final conceptual site model (CSM) is based on an evaluation of existing data and the current and reasonably likely future conditions at the site (Figure 3). This model provides the framework for assessing potential exposure pathways to be considered in the risk assessments.

To be considered complete, an exposure pathway must have: (1) an identified source of COPCs; (2) a release/transport mechanism from the source; and (3) a receptor to which contact can occur. At this site, likely or potential sources include former USTs, former ASTs, machine shop areas, paint/battery/waste oil/drum/chemical storage, railroad spur, and miscellaneous spills and leaks.

Potentially Exposed Populations. A beneficial land and water use survey has

been completed for the site and is discussed in Section 2.4 (Hahn and Associates, 2001). Based on the Central Residential (RX) zoning designation, it is expected that the site will be used for mixed-use residential/commercial development in the future. The only identified beneficial use for groundwater in the locality of the facility is discharge to the Willamette River.

Therefore, the final CSM assumes the future area land use will be a mix of residential and commercial and that groundwater beneath the site is not and likely will not be used for drinking water. Figure 3 presents the final CSM for this site. The red boxes on the figure indicate potentially complete pathways to the indicated receptor. In addition to residential and commercial receptors, the HHRA will also evaluate utility/excavation workers as potentially exposed populations. Utility/excavation workers will be identified as excavation workers in the remainder of the HHRA.

Potentially Complete Exposure Routes. Exposure pathways for quantitative analysis were selected based on the final CSM developed for this site. Based on available information, the exposure pathways evaluated in this HHRA are:

- Incidental ingestion of soil (all receptors);
- Dermal contact with soil (all receptors);
- Inhalation of fugitive dust from surface soil (residents and commercial workers);
- Inhalation of fugitive dust from total soil (0 to 15 feet below ground surface, excavation workers); and
- Inhalation of VOCs from groundwater (all receptors; indoor for residents and commercial workers; outdoor air only for excavation workers). No VOCs were identified as soil COPCs (see Tables 1 through 3). Outdoor air was not evaluated for residents and commercial workers since the risks and hazards associated with indoor air, which are higher than those associated with outdoor air, were acceptable.

Direct contact with groundwater is not considered a potential exposure pathway for excavation workers, as the average depth of the shallow WBZ was reported to be 23 feet bgs (Hahn and Associates, 2001a). For this HHRA, residents and commercial workers are assumed to be exposed to soil down to a depth of 3 feet below ground surface (bgs) and excavation workers are assumed to be exposed to soils down to a depth of 15 feet bgs.

Areas of Concern. The T1S Site is being redeveloped for residential and commercial purposes. The site will be developed into three areas (A, B, and C)

which were evaluated as separate areas of concern (AOCs). Separate COPCs were identified and separate risk calculations conducted for each AOC. The RI identified six general areas/locations of soil impacted with petroleum hydrocarbons. Area A includes the B-20 Area, B-38 Area, and B-102 Area. Area B includes the B-5 Area, B-29 Area, and B-37 (Dry Well) Area. Area C does not include any areas/locations of soil impacted with petroleum hydrocarbons. The AOCs for this site are presented on Figure 2.

3.1.2 Development of Exposure Point Concentrations

Exposure point concentrations (EPCs) represent the chemical concentrations in the soil and groundwater that the receptor will potentially contact during the exposure period. The EPCs for the site's COPCs were derived from either data obtained from sampling or from a combination of sample data and fate and transport modeling. For example, air EPCs were modeled from groundwater EPCs for volatile constituents. Groundwater data from monitoring well samples collected in September and October 2001 were used to represent current and future groundwater conditions.

The residential and commercial worker scenarios were evaluated based on exposure to surface soil (0 to 3 feet bgs), while the excavation worker scenario was based on exposure to surface and subsurface soil (0 to 15 feet bgs). No VOCs were identified as soil COPCs, therefore, soil from 15 feet bgs down to groundwater was not considered in the volatilization to indoor and outdoor air pathways.

In accordance with EPA guidance (EPA, 1989) for chemicals detected at one sampling location but not at others, a proxy concentration equal to half the sample quantification limit (SQL) were used to represent the concentration of the chemical of concern in a sample where it is not detected.

The 90 percent upper confidence limit (UCL) on the arithmetic mean concentration of COPCs in each environmental medium of concern were used to evaluate the reasonable maximum exposure (RME) scenario, while the arithmetic mean were used to evaluate the central tendency (CT) exposure scenario (EPA, 1989). The RME scenario is intended to be a conservative estimate of potential exposure, while the CT exposure scenario is intended to be a more realistic exposure scenario. Using both the RME and CT allows for a range of potential risk and hazard estimates. The 90 percent UCL is calculated based on EPA (1992) guidance. The manner of calculating the 90 percent UCL were as follows:

- As a first step, the underlying distribution of the data was evaluated using the

Shapiro and Wilk W-Test (Gilbert, 1987) to determine if the data are normal or lognormal. If the normal and lognormal distributions are indicated, the 90 percent UCL were calculated appropriately.

- If the normality test rejects both normal and lognormal distributions at a significance level of 95 percent, the test was rerun by adjusting the W-Test quantile downward by 0.1 from the original quantile (providing a greater tolerance for accepting a distribution). If the data set conforms to a normal or lognormal distribution with the greater tolerance, the distribution was reported as weak lognormal (or weak normal).
- If the normal and lognormal distributions are rejected with the greater tolerance, the data were assumed to fit a lognormal distribution for calculation of the 90 percent UCL (assumed lognormal distribution; EPA, 1992).
- In cases where the 90 percent UCL or the calculated mean concentration exceed the maximum detected value (which can occur in data sets with a large variance), the maximum detected value were used to define the upper limit of this range.

EPCs for this HHRA are presented in Table 4. All of the EPCs presented in Table 4 were calculated using the methodology presented above, with the following exceptions:

Area A: Total Soil (0 to 15 feet bgs). The 90 percent UCL for benzo(a)anthracene of 0.35 mg/kg is less than the arithmetic mean of 0.37 mg/kg. This is primarily due to the elevated detection of 9.35 mg/kg, which was detected in the soil sample B-68. The RME concentration for benzo(a)anthracene was, therefore, set at 0.37 mg/kg.

Area B: Total Soil (0 to 15 feet bgs). The 90 percent UCLs and arithmetic means for the cPAHs were significantly affected by the elevated SQL of 67 mg/kg in soil sample B-63. Since one-half of 67 mg/kg is over 10 times greater than the maximum detected concentrations of the five cPAHs, the cPAH results for soil sample B-63 were not included in the statistical evaluation for this data set. However, subsurface soil samples collected adjacent to sample B-63 (e.g., Samples B-66 and B-67) had detected concentrations of cPAHs that were included in the calculations of EPCs. Therefore, this area was represented in the calculated risk estimates and the exclusion of cPAH SQLs from Sample B-63 had no impact on HHRA objectives.

The inhalation of particulates and VOCs pathways were evaluated using the fate and transport models presented in DEQ's risk assessment guidance (DEQ, 2000) and risk-based decision-making guidance (DEQ, 1999).

3.1.3 Exposure Factors

To quantitate intake estimates for site-related chemicals, EPCs are combined with variables that describe the exposed population (e.g., contact rate, exposure frequency and duration, body weight). Exposure factors were selected using standard default exposure factors presented in Guidance for Conduct of Deterministic Human Health Risk Assessments (DEQ, 2000). Industrial exposure assumptions were used to evaluate the commercial scenario.

The following paragraphs describe the exposure pathways proposed for evaluation in this HHRA.

Incidental Soil Ingestion. Incidental ingestion of soil is often a primary route of exposure to particulate-bound chemicals. Individuals have been observed to ingest small amounts of soil as a result of hand-to-mouth behavioral patterns that may follow soil contact activities. RME and CT factors applicable to this pathway for the identified human receptors are summarized in Table 5.

Dermal Soil Contact and Absorption. In addition to leading to incidental soil ingestion, soil contact can also result in absorption of some chemicals directly through the skin. RME and CT exposure factors for the dermal contact pathways are summarized in Table 6. Dermal absorption rates have not been well defined in the available literature. Current RME and CT dermal absorption factors were selected from DEQ Human Health Risk Assessment Guidance (DEQ, 2000).

Air Inhalation. Exposure to chemicals present in soil and groundwater may also result from inhalation of vapors and/or fugitive dust generated at the site. RME and CT factors applicable to this pathway are summarized in Tables 7 and 8.

3.2 Toxicity Assessment

The objectives of the toxicity assessment are to evaluate the inherent toxicity of the compounds under investigation and to identify and select toxicological measures for use in evaluating the significance of the exposure. These toxicological measures or criteria were used in conjunction with intake rates for chemicals of concern in the risk characterization process of the human health risk assessment.

Standard human health risk assessment toxicity databases were used to derive health-based toxicity criteria. The hierarchy of sources for toxicity criteria for use in this risk assessment will follow as presented in OAR 340-122-084. The hierarchy of toxicity criteria is as follows:

(1) EPA's Integrated Risk Information System (IRIS, EPA 2000b);

(2) EPA's Health Effects Assessment Summary Table (HEAST, EPA 1997);

(3) EPA-NCEA Superfund Health Risk Technical Support Center;

(4) Other U.S. EPA documents or databases;

(5) ATSDR minimal risk levels (MRLs); and

(6) Other professionally peer-reviewed documents as needed and as approved by DEQ.

3.2.1 Types of Toxicity Values for Quantifying Risks

Toxicity and risk assessments vary for different chemicals depending upon whether non-carcinogenic or carcinogenic responses (i.e., endpoints) are used to assess potential risks. These criteria, in turn, are based on the endpoints observed from laboratory or epidemiological studies with the chemicals. Some chemicals of concern may result in both non-carcinogenic and carcinogenic effects, although in many cases the EPA has published toxicity criteria for only the most sensitive type of toxic effect supporting the most restrictive toxicological criteria. The toxicity criteria used in this HHRA are presented in Table 9.

Reference Doses (RfDs). Reference doses are used to quantitatively evaluate non-carcinogenic toxicity of a specific chemical. Reference doses are established at levels associated with no adverse effect—the "no observed adverse effect level" (NOAEL). In general, the RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

RfDs are developed from an analysis of the available toxicological literature from which a critical study is selected. The selection of a critical study is made by professional judgment and considers factors such as the quality of the study, the relevance of the study to human exposures, and other factors. Good quality human toxicological data are preferred to animal studies. If human data are not available, the study on the most sensitive species is selected as the critical study. Similarly, the toxic effect manifested at the lowest exposure level is (generally) selected as the critical effect.

Cancer Slope Factors (SFs). The toxicity of potential human carcinogens is evaluated differently. It is assumed for carcinogens that no threshold concentrations exist below which adverse effects may not occur. Probabilistic methods based on chemical-specific dose-response curves are used to establish slope factors, which are

then used to quantify potential risks from exposure to carcinogens.

Dose-response curves are generated in laboratory studies using high chemical concentrations. The dose-response curve is fitted to a linearized multistage model that extrapolates the slope of the curve from high experimental concentrations to low concentrations at which people are typically exposed. The final slope factor (SF) is based on the 95 percent UCL of the extrapolated slope of the dose-response curve. Because of the non-threshold assumption and the UCL statistical procedure, the use of published slope factors provides a conservative upper-bound estimate of potential risks associated with exposure.

3.2.2 Modification of Oral Toxicity Values for Evaluating Dermal Exposure

Oral toxicity values are expressed as administered doses. When evaluating dermal exposure to contaminants from soil and water, it is necessary to adjust the oral toxicity value (which is based on an administered dose) to one based on an absorbed dose using a chemical's oral absorption efficiency. However, according to EPA guidance (2000a), the only chemical for which an adjustment is recommended at this time is cadmium. Adjustment is not recommended for other chemicals because a scientifically defensible database does not exist for making the adjustment. Therefore, in this HHRA, because cadmium is not a COI at this site, no adjustments of oral toxicity factors to evaluate dermal exposure were done.

3.2.3 Toxicity Assessment for Lead

Lead is a unique chemical in its pharmacokinetic and toxicological properties. Although classified as both a potential carcinogen (B2 weight of evidence) and a non-carcinogen, lead is most often assessed as a non-carcinogen only, since these effects manifest themselves at doses lower than those for carcinogenicity. However, in contrast to the assumption of the existence of a threshold for non-carcinogenic responses, there does not appear to be a threshold below which lead does not exert a response.

Currently, the EPA provides neither a reference dose for evaluating the non-carcinogenic effects (unrelated to cancer) nor a slope factor for evaluating the carcinogenic effects for lead. EPA has developed an exposure model for lead that considers both its biokinetics and toxicological properties. This model—the "Integrated Exposure Uptake and Biokinetic" (IEUBK) model—integrates the intake of lead from multiple sources, including soil, food, and water ingestion, inhalation, and, when appropriate, maternal contributions. Intakes are assessed for children from ages 0 (birth) to seven. The model does not assess lead

intakes for older children or adults. Childhood exposure to lead is the focus of this model because this receptor group is recognized as the most sensitive to the non-carcinogenic effects of inorganic lead. Therefore, to evaluate lead exposures at the T1S Site, we will use other criteria as described below.

Soil exposures at the site are limited to residents and commercial workers contacting soil at the ground surface or excavation workers contacting soil during trenching or excavation activities. We screened the soil lead concentrations against the EPA Region 9 residential soil PRG for lead (400 mg/kg) to evaluate residential exposure and the adult soil screening level for lead (750 mg/kg) to evaluate commercial and excavation exposures.

Lead has been detected in groundwater at the site. However, as lead is not volatile and no direct contact exposure pathways have been identified to human receptors, lead in groundwater will not be further evaluated in the HHRA.

3.2.4 Toxicity Assessment for Total Petroleum Hydrocarbons (TPH)

Determining appropriate toxicity values for TPH (a class of compounds identified as a COI at this site) is difficult because of the characteristics of TPH. TPH are a complex mixture of hundreds or more individual alkanes, cycloalkanes, alkenes, aromatics, and other petroleum substances. For this HHRA, the human health risks associated with TPH were evaluated using an indicator approach. The indicators refer to single compounds within TPH known or believed to be carcinogenic and non-carcinogenic and which are evaluated individually. The indicator compounds that were quantitatively evaluated in this HHRA are:

- **Volatiles (BTEX):** *benzene, toluene, ethylbenzene, and xylene; and*
- **Polynuclear Aromatic Hydrocarbons (PAHs):** anthracene, acenaphthene, benzo(a)pyrene, pyrene, naphthalene, chrysene, ideno(1,2,3-cd)pyrene, benzo(k)flouranthene, flourene, naphthalene, benzo(b)flouranthene, benzo(a)anthracene, and dibenzo(a,h)anthracene.

3.3 Risk Characterization

Risk characterization is the process of comparing the chemical intake by a receptor to the toxicity of the chemical. This comparison is expressed either as a hazard index (non-carcinogens) or an excess lifetime risk of cancer (carcinogens).

3.3.1 Methods Used to Quantify Risks and Hazards

As discussed in Section 3.2, non-carcinogenic chemical effects are quantitatively evaluated using a RfD, while carcinogenic chemical effects are evaluated using a SF.

Non-Carcinogenic Effects. For the residential exposure pathway, the non-carcinogenic intakes are based on child exposures, which are more conservative than potential adult exposures. The daily intake of each compound resulting from site exposure is divided by the available RfD value for the compound to compute a hazard quotient (HQ), as follows:

$$HQ = CDI/RfD$$

where:

CDI = Chronic daily intake; the estimated exposure level over a given time period in mg/kg-day.

RfD = Reference Dose; the exposure level that is likely to be without deleterious effects during a given time increment in mg/kg-day. Only chronic RfDs were used for this risk assessment.

Carcinogenic Effects. For the residential exposure pathway, the carcinogenic intakes are based on combined adult and child exposures, which are more conservative than child or adult exposures calculated separately. An estimated excess lifetime cancer risk is calculated using:

$$Risk = CDI \times SF$$

where:

CDI = Chronic daily intake; the estimated lifetime exposure level in mg/kg-day.

SF = Slope Factor; the upper-bound estimate of the probability of a cancer response per unit of intake of a chemical over a lifetime, expressed as $(mg/kg\text{-}day)^{-1}$.

Cumulative Hazard and Risk Estimates. For simultaneous exposure to multiple chemicals with similar toxic effects or target organ, a Hazard Index (HI) is calculated as the sum of chemical-specific HQs. A toxic effect is considered possible if a HI or HQ exceeds 1 (OAR 340-122-115).

For simultaneous exposure to multiple chemicals, individual risk estimates are summed to provide pathway, media, and receptor total risk estimates. Combining potential cancer risks as a result of exposure to multiple chemicals through multiple exposure pathways assumes the following:

- Exposure to all COPCs will result in the same effect (cancer); and
- Each COPC exerts its effect independently (i.e., there is no synergism or antagonism).

OAR 340-122-115 considers 1×10^{-6} and 1×10^{-5} to be acceptable risk levels for individual and multiple carcinogens, respectively.

3.3.2 Risks and Hazards Associated with Current and Future Site Conditions

Risk and hazard estimates for each area are discussed in Sections 3.3.2.1 through 3.3.2.3. As discussed previously, the residential, commercial worker, and excavation worker exposure scenarios are evaluated for each area. Risk and hazard estimate calculations for each area, exposure pathway, and receptor are presented in Appendix B (Tables B-1 through B-9). Table 10 presents the totals as a sum of risks and hazards associated with each individual exposure pathway, while Table 11 presents the RME carcinogenic risk estimates as a sum of risks associates with each COPC.

3.3.2.1 Area A Risk and Hazard Estimates

The exposure pathways that were quantitatively evaluated at Area A are soil ingestion, dermal contact with soil, inhalation of volatiles from groundwater, and inhalation of fugitive dust.

Resident. The cumulative RME and CT excess lifetime cancer risks for the residential receptor are estimated to be 2×10^{-4} and 2×10^{-6}, respectively. The RME risk estimate is greater than the OAR 340-122 acceptable level of 1×10^{-5} for cumulative carcinogenic risk, while the CT risk estimate is less than the DEQ acceptable risk level. The primary exposure pathways (RME evaluation) are soil ingestion (risk = 8×10^{-5}) and dermal contact with soil (risk = 8×10^{-5}). COPCs that exceed the DEQ acceptable risk level of 1×10^{-6} for individual carcinogens are benzo(a)pyrene (risk = 9×10^{-5}), arsenic (risk = 5×10^{-5}), benzo(a)anthracene (risk = 1×10^{-5}), *dibenz(a,h)anthracene (risk = 8×10^{-6}), benzo(b)fluoranthene* (risk = 7×10^{-6}), and indeno(1,2,3-cd)pyrene (risk = 4×10^{-6}).

The cumulative RME and CT HIs for the residential receptor are estimated to be 1.0 and 0.01, respectively. The RME HI is equal to, while the CT HI is less than, the DEQ acceptable HI of 1.0.

Commercial Worker. The cumulative RME and CT excess lifetime cancer risks for the commercial worker are estimated to be 1×10^{-5} and 6×10^{-7}, respectively. The RME risk estimate is equal to, while the CT risk estimate is less than, the DEQ acceptable level of 1×10^{-5} for cumulative carcinogenic risk. The primary exposure pathways (RME evaluation) are soil ingestion (risk = 1×10^{-5}) and dermal contact with soil (risk = 3×10^{-6}). Individual COPCs that exceed the DEQ acceptable risk level of 1×10^{-6} for individual carcinogens are benzo(a)pyrene (risk = 7×10^{-6}) and arsenic (risk = 5×10^{-6}).

The cumulative RME and CT HIs for the residential receptor are estimated to be 0.03 and 0.006, respectively. The RME and CT HI are less than the DEQ acceptable HI of 1.0.

Excavation Worker. The cumulative RME and CT excess lifetime cancer risks for the excavation worker are estimated to be 5×10^{-8} and 3×10^{-9}, respectively. The RME and CT risk estimates are less than the DEQ acceptable risk level for multiple carcinogens. The cumulative RME and CT HIs for the residential receptor are estimated to be 4×10^{-3} and 5×10^{-4}, respectively. Both of which are well below the acceptable HI of 1.0.

3.3.2.2 Area B Risk and Hazard Estimates

The exposure pathways that were quantitatively evaluated at Area B are soil ingestion, dermal contact with soil, and inhalation of fugitive dust. No VOCs were detected in Area B soil or groundwater.

Resident. The cumulative RME and CT excess lifetime cancer risks for the residential receptor are estimated to be 3×10^{-5} and 5×10^{-7}, respectively. The RME risk estimate is greater than, while the CT risk estimate is less than, the acceptable risk level of 1×10^{-5} for cumulative carcinogenic risk, while the CT risk estimate is less than the DEQ acceptable risk level. The primary exposure pathways (RME evaluation) are soil ingestion (risk = 2×10^{-5}) and dermal contact with soil (risk = 1×10^{-5}). COPCs that exceed the DEQ acceptable risk level of 1×10^{-6} for individual carcinogens are benzo(a)pyrene (risk = 9×10^{-6}) and arsenic (risk = 2×10^{-5}).

The cumulative RME and CT HIs for the residential receptor are estimated to be 0.4 and 0.01, respectively. Both of which are less than the DEQ acceptable HI of 1.0.

Commercial Worker. The cumulative RME and CT excess lifetime cancer risks for the commercial worker are estimated to be 2×10^{-6} and 3×10^{-7}, respectively. The RME and CT risk estimates are both less than the DEQ acceptable level of 1×10^{-5} for cumulative carcinogenic risk. Arsenic (risk = 2×10^{-6}) is the only individual COPC that exceeds the DEQ acceptable risk level of 1×10^{-6} for individual carcinogens. The cumulative RME and CT HIs for the residential receptor are estimated to be 0.01 and 0.006, respectively. The RME and CT HI are less than the DEQ acceptable HI of 1.0.

Excavation Worker. The cumulative RME and CT excess lifetime cancer risks for the excavation worker are estimated to be 1×10^{-7} and 4×10^{-9}, respectively. The RME and CT risk estimates are less than the DEQ acceptable risk level for multiple carcinogens. The cumulative RME and CT HIs for the residential receptor are estimated to be 3×10^{-3} and 4×10^{-4}, respectively. Both of which are well below the acceptable HI of 1.0.

3.3.2.3 Area C Risk and Hazard Estimates

The exposure pathways that were quantitatively evaluated at Area C are soil ingestion, dermal contact with soil, and inhalation of fugitive dust. No VOCs were detected in Area C soil or groundwater. Arsenic is the only COPC for Area C.

The cumulative RME and CT excess lifetime cancer risks for all receptors (resident, commercial worker, and excavation worker) are less than the acceptable risk level of 1×10^{-5} for cumulative carcinogenic risk, with the exception of the RME residential scenario (risk = 2×10^{-5}). Arsenic has individual cancer risk estimates of 2×10^{-5} and 2×10^{-6} for the RME residential and commercial worker scenarios, respectively. All individual and cumulative hazard estimates are less than the DEQ acceptable HI of 1.0.

3.3.2.4 Lead Risk Evaluation

Lead was only identified as a COPC in Area A. Therefore, the discussion in this section only concerns Area A.

Resident. The RME and CT lead EPCs in surface soil (0 to 3 feet bgs) are 6,190 mg/kg and 540 mg/kg, respectively. Both of these concentrations exceed the EPA Region 9 residential soil PRG of 400 mg/kg, indicating that there is a potential for adverse health effects from exposure to lead in surface soil at Area A. The RME and CT lead EPCs in surface soil are driven by the maximum detected lead concentration of 6,190 mg/kg, which was detected in sample B-

68. If sample B-68 was removed from the Area A surface soil data set, the RME and CT EPCs for the remaining data would be 192 mg/kg (based on the maximum detected concentration) and 30 mg/kg, respectively.

Commercial Worker. The RME lead EPC in surface soil at Area A (6,190 mg/kg) exceeds, while the CT EPC is less than, the EPA Region 9 industrial soil PRG of 750 mg/kg. As discussed above, if the maximum detected concentrations were removed from the data set, the RME and CT lead EPCs would be acceptable for the commercial worker.

Excavation Worker. The RME and CT lead EPCs in total soil (0 to 15 feet bgs) are 5,000 mg/kg and 430 mg/kg, respectively. The RME lead EPC exceeds, while the CT EPC is less than, the EPA Region 9 industrial soil PRG of 750 mg/kg. The RME and CT lead EPCs in total soil are also driven by the maximum detected lead concentration of 6,190 mg/kg that was detected in sample B-68. If sample B-68 were removed from the Area A total soil data set, the remaining maximum detected concentration would be 807 mg/kg, which just slightly exceeds the industrial soil lead PRG.

3.4 Uncertainty Analysis

It is important to fully specify the assumptions and uncertainties inherent in the risk assessment to place the risk estimates in proper perspective. For this risk assessment, the general sources of uncertainty that are addressed include:

- Data collection and evaluation;
- Exposure assessment;
- Toxicity assessment; and
- Risk characterization.

3.4.1 Data Collection and Evaluation

The identification of the types and numbers of environmental samples, sampling procedures, and sample analysis each contain components that contribute to uncertainties in this risk assessment. For example, it is generally not practical to sample all locations and media at a site. Decisions were made to select a subset of the potential sampling locations and media based upon the anticipated presence of the chemical. These decisions were made with the use of historical and background information of the site and the potential contaminants' chemical and physical properties. Exposure doses for the site that are based on non-random, or hot spot, samples may be overestimated.

3.4.2 Exposure Assessment

The exposure estimation methods are subject to varying degrees of uncertainty. The degree of uncertainty generally depends on the amount of site-specific data available. The following sources of uncertainty have been identified.

Exposure Scenario Identification. This HHRA assumes that receptors are limited to residents, commercial workers, and excavation workers. If this assumption is incorrect, future risks and hazards could be under- or overestimated.

Exposure Parameters and Assumptions. The standard and site-specific exposure assumptions may or may not be representative of the actual exposure conditions and could under- or overestimate future risks and hazards.

Calculation of Exposure Point Concentrations. The 90 percent UCL on the arithmetic mean, or the maximum detected concentration, whichever is lower, was used as the exposure point concentration (EPC) in this HHRA. Prior to the calculation of the 90 percent UCL, each data set was evaluated to determine whether the data were distributed normally or lognormally. As discussed previously, if a data set was found to be neither normal nor lognormal, the data set was evaluated as a lognormal data set. A lognormal distribution is common among environmental data sets. The maximum detected COPC concentrations, especially at Area A, has a significant effect on the EPCs used in this HHRA.

- **Area A.** Carcinogenic PAHs , arsenic and lead were identified as compounds of concern (COCs) in surface soil, while only lead was identified as a subsurface COC. The surface soil exposure concentrations for cPAHs, arsenic, and lead are driven by the maximum detected concentration of each COPC, which was detected in soil sample B-68 (B-94 for dibenz(a,h)anthracene). The second highest cPAH detections were found in soil sample B-94 (detected between 1 and 2 mg/kg). The remaining cPAH detections are less than 0.5 mg/kg, which are consistent with ambient levels of cPAHs in urban areas.

  Arsenic was detected at a concentration of 12.9 mg/kg in sample B-68 and at a concentration of 7.53 mg/kg in sample B-97. All other arsenic detections were less than the Terminal 1 arsenic background level of 5.3 mg/kg (Hahn and Associates, 2001a). Additionally, if the arsenic concentration of 12.9 mg/kg were removed from the Area A surface soil data set, the resulting arithmetic mean concentration of the remaining data would be 2.2 mg/kg.

  As discussed previously, the maximum detected lead concentration in surface soil at Area A was 6,190 mg/kg. The second highest lead detection was 192 mg/kg, which is below the residential and industrial (or commercial)

soil screening levels. Lead is the only COPC identified in the HHRA as a subsurface compound of concern (i.e., detected at levels above DEQ acceptable levels).

- **Area B.** Benzo(a)pyrene and arsenic were identified as COCs in surface soil. No subsurface COCs were identified at Area B. The maximum detected concentration of benzo(a)pyrene and the other three cPAHs evaluated are less than 0.2 mg/kg. These levels are consistent with ambient levels of cPAHs in urban areas.

  Arsenic was detected at a maximum concentration of 3.1 mg/kg in surface soil, which is less than the Terminal 1 arsenic background level of 5.3 mg/kg (Hahn and Associates, 2001a).

- **Area C.** Arsenic was identified as a COC in surface soil. No subsurface COCs were identified at AOC C. Arsenic was detected at a maximum concentration of 2.9 mg/kg in surface soil, which is less than the Terminal 1 arsenic background level of 5.3 mg/kg (HAI, 2001a).

Assumption of Steady-State Conditions. The inherent assumption is that future COPC concentrations are the same as current concentrations. In general, this assumption overestimates COPC concentrations and resulting exposure intakes.

Chemical Characterization. The sampling strategy used in collecting the soil samples that were used in this HHRA was purposive rather than random. Because the potential current and future receptors are assumed to visit the entire site, not just the areas that are contaminated, the exposure point concentrations used likely overestimate potential risks and hazards.

Modeling Procedures. DEQ's Risk-based Decision Making guidance was used to estimate the volatilization from groundwater to indoor and outdoor air. The assumptions used in these models introduce uncertainty to the degree that they do not reflect actual conditions. There is significant uncertainty associated with the volatilization model used to estimate indoor and outdoor air concentrations based on soil and groundwater concentrations. Areas of uncertainty include, but are not limited to:

- **COPC Concentration:** The model assumes the COPC concentrations are homogeneous over the entire area being evaluated. Since some COPC concentrations are based on the maximum detected concentration, this is a conservative assumption that is likely to significantly overestimate the amount of contamination present.
- **Building Parameters:** The model uses various building parameters as a basis for the indoor air concentrations such as building volume to area ratio

(essentially the height of the building), building air exchange rate (the amount of times the air in the building is replace per second), the foundation crack thickness, and the foundation crack fraction (that is, the fraction of the building floor that contains cracks). Many of these assumptions have a linear effect on the model output (that is, if the air exchange rate is doubled, the indoor air concentration would drop in half). The model also assumes there is no vapor barrier under the foundation and that the building is not under positive pressure. Default building parameters were used in this HHRA.

- **COPC-Specific Parameters:** The model uses various chemical parameters such as diffusion coefficients, Log K_{oc} or Log K_d, Henry's Law Constant, vapor pressure, and solubility. These values can vary considerable in the literature. Default chemical parameters included in the RBDM model were used. These COPC-specific parameters can have a significant effect on the model results and, therefore, the degree that the parameters used represent actual conditions at the site may lead to an overestimation or underestimation of actual air concentrations.

3.4.3 Toxicity Assessment

Whether verified by consensus among EPA scientists or not, uncertainty is present in the derivation of toxicity factors, and several assumptions are necessary. The factors used in the derivation of toxicity factors that add uncertainty to the results are presented below.

- **Extrapolation from Animal Studies.** Extrapolating human health risks from animal studies is complicated by physiological and pharmacokinetic differences. Similar toxic effects are not always observed in all species or at similar relative concentrations (when corrected for body weight). These extrapolations may overestimate or underestimate the actual chemical toxicity to humans.
- **High-Dose to Low-Dose Extrapolations.** Toxicity values are generally based on laboratory studies using high chemical exposures. Dose-response trends observed at high doses are generally assumed to be linear at low doses. Because dose-response relationships at low doses are largely unknown, assuming a linear relationship may overestimate or underestimate chemical toxicity at concentrations in the extrapolated range.
- **Population Variability.** Laboratory animal studies generally use animal strains that are genetically similar, yet the human population is genetically diverse. Because methods for estimating toxicity in more susceptible individuals, such as children, are largely undeveloped, such estimates may overestimate or underestimate chemical toxicity.

- **Available Studies.** Not all toxicity values are based on the same amount or quality of research. As new studies are performed and reviewed, toxicity values can change. The less information available on a chemical, the greater the possibility that chemical toxicity will be overestimated or underestimated.

The uncertainties discussed above are addressed when developing RfDs by dividing the no observable adverse effect level (NOAEL) from animal studies by uncertainty factors of up to 10,000.

Uncertainty associated with determining chemical carcinogenicity is reflected in the weight-of-evidence classification groups assigned to carcinogens. In addition, uncertainties are introduced because SFs are derived from the low-dose end of the dose-response curves, and the experimental studies are usually conducted at the high-dose end of the curve. The selected 95 percent UCL of the slope of the dose-response curve is considered an upper-bound toxicity value. Therefore, it is unlikely that the SFs will underestimate risk. Actual cancer risk may range from a low of zero to the upper limit defined by the model.

Uncertainty is also associated with using oral toxicity factors to evaluate dermal exposures. The use of oral toxicity factors as surrogates is necessary because there are no dermal toxicity factors approved by EPA. Most of the uncertainty exists because it is not known whether the compounds in question exhibit the same toxicity via dermal contact as they do via the oral pathway. Default oral absorption factors were used to adjust the oral toxicity factors so that the absorbed doses calculated for the dermal pathway could be evaluated. The use of the oral absorption factors may bias the risk and hazard estimates high or low.

The use of surrogate toxicity factors for chemicals lacking toxicity factors may under- or overestimates the potential risks or hazards.

3.4.4 Risk Characterization

This HHRA used EPA's standard algorithms to calculate chemical intakes and associated health risks and hazards. There are certain assumptions inherent in the use of these equations that add uncertainty. For example, calculations of carcinogenic risks and non-carcinogenic HIs assume the additivity of toxic effects. This assumption adds uncertainty to the assessment and may result in an overestimation or underestimation of the potential risks, depending on whether synergistic or antagonistic conditions apply. Exposure pathway risks are combined assuming that a single receptor may be exposed to contamination through a selected number of pathways concurrently. This is a conservative estimate that may overestimate risks and hazards. Additionally, the standard algorithms used do not consider certain factors, such as absorption or matrix

effects. In cases where these processes are important, the risk estimates may overestimate or underestimate the potential human risks at this site.

4.0 LEVEL 1 SCOPING ECOLOGICAL RISK ASSESSMENT

The purpose of the Level 1 Scoping ERA is to provide a qualitative determination of whether there is any reason to believe that ecological receptors and/or exposure pathways are present or potentially present at or in the locality of the facility. The outline for the Level 1 Deliverable (Ecological Risk Assessment Guidance; Attachment 3, DEQ, 1998) was generally followed for presenting the results of the Level 1 evaluation in this section. The existing data summary and the results of the land and water use survey are presented in earlier sections of this report. Appendix C presents photographs taken at the T1S Site during the site visit and Appendix D presents DEQ's Ecological Scoping Checklist.

In addition to the Level 1 Scoping ERA, a Modified Level 2 Screening ERA was conducted on the groundwater data available for this site. The Modified Level 2 Screening ERA was conducted to determine whether constituents were present in groundwater at levels of concern for aquatic ecological receptors.

4.1 Sensitive Environments

The site and surrounding properties are all zoned heavy industrial and are being used for these purposes. The Willamette River borders the T1S Site on the east. The T1S Site has been historically used for commercial use and the entire site has been developed. The site does not provide high quality habitat to the local ecological community. There are no designated wetlands on the locality of the facility. There are also no identified sensitive environments in the locality of the facility.

4.2 Threatened and Endangered Species

The Oregon Natural Heritage Program (ONHP), which monitors threatened and endangered (T&E) plants and wildlife, conducted a data search of T&E species within a two-mile radius of the site. A letter from the ONHP is included in Appendix E. The ONHP identified the historical presence of the following species:

Federal Species Listed as Threatened

- *Oncorhynchus mykiss* (Steelhead [Lower Columbia River and Upper Willamette River]).

- *Oncorhynchus tshawytscha* (Chinook salmon [Lower Columbia River and Upper Willamette River]).

Candidate for Federal Listing as Threatened

- *Oncorhynchus kisutch* (Coho salmon [Lower Columbia River]).

Federal Species Listed as Proposed Threatened

- *Oncorhynchus clarki clarki* (Coastal cutthroat trout [Columbia River/SW Washington).

Federal Species of Concern

- *Corynorhinus townsendii townsendii* (Pacific Western Big-Eared Bat) – Last observed in 1928.
- *Antrozous pallidus pacificus* (Pacific Pallid Bat) – Last observed in 1927.
- *Clemmys marmorata marmorata* (Northwestern Pond Turtle).
- *Aster Curtus* (White-Topped Aster) – This population is assumed extinct.

State Species Listed as Endangered

- *Falco peregrinus anatum* (American Peregrine Falcon) – Nesting observed in 1997.

State Species Listed as Sensitive-Critical

- *Chrysemys picta* (Painted Turtle).

State Species Listed as Critical

- *Cimicifuga elata* (Tall Bugbane) – Last observed in 1993.

T&E species were not observed in the upland portions of this site on our ecological scoping visit.

4.3 Site Visit Summary

This section describes the results of Hart Crowser's October 2, 2001, visit to the site to assess whether ecological receptors and/or exposure pathways are present or potentially present at or in the locality of the site. The discussion of ecological features present at the facility is based on our on-site observations. Photographs taken during the site visit are provided in Appendix C.

4.3.1 Observed Impacts

Impacts to the site and surrounding properties attributable to contaminated environmental media were not observed. The entire site has been developed for commercial and industrial use; as such, native vegetation has been replaced with buildings and pavement.

4.3.2 Ecological Features

Ecological features were assessed by evaluating the habitat within the locality of the facility. Appendix D presents the checklists used in this evaluation.

Upland. The T1S Site consists of approximately 21-acres of flat terrain with limited on-site vegetation. The site is 99 percent ruderal and 1 percent vegetated (Figure 2 and Photos in Appendix C). Upland vegetation is limited to a small bank area that slopes immediately bordering the Willamette River. The types of vegetation observed in this bank area were limited to invasive, weedy species such as Blackberry (*Bubus sp.*). Additionally, limited vegetation was observed in cracks in the pavement throughout the site. In general, the entire upland site has been paved or developed and provides very poor habitat quality and extremely limited potential for exposure to terrestrial ecological receptors.

4.3.3 Ecologically Important Species and Habitats

Ecologically important terrestrial species, including threatened or endangered animals were not observed on or adjacent to the site.

4.4 Exposure Pathways

A general evaluation of potential receptor-pathway interactions is provided in the checklists presented in Appendix D and is presented in the Ecological CSM on Figure 4. As summarized on the checklists provided in Appendix D, COPCs are currently present in soils within the locality of the facility. However, there are no current exposure pathways present for these contaminants to reach ecological receptors within the locality of the facility. The majority of the site is currently paved or is covered by buildings. The absence of upland habitat

results in no complete exposure pathways to terrestrial species. The fact that the majority of the site is paved or developed limits the potential for overland transport (via surface erosion of soil) to cause migration of any contamination present in surface soil to the Willamette River.

The RI found no evidence of free phase product to be present in soil, and no migration or direct release of product from the T1S Site to the adjacent Willamette River is expected at this site. The Preliminary Assessment (PA) completed for this site by the Port (Port of Portland, 2000) evaluated the potential for storm water discharges to transport contaminants from the T1S Site to the Willamette River. The PA concluded that "there is also a low potential for upland activities to have resulted in releases to the Willamette River via stormwater discharges".

Groundwater data collected from push-probe explorations as part of the RI suggested the potential for site related contaminants to be present in site groundwater. A groundwater monitoring program was initiated by Hahn and Associates and seven monitoring wells were installed at the T1S Site (Hahn and Associates, 2001b). Because the movement of shallow groundwater at the site has been found to be in the direction of the Willamette River, a modified Level 2 Screening ERA was conducted on the available groundwater monitoring data to determine whether contaminants are present in groundwater at concentrations at levels of potential concern to ecological receptors.

The procedures for conducting a Modified Level 2 Screening ERA were presented in the Risk Assessment Work Plan for this site (Hart Crowser, 2001) and further discussed with DEQ in Port of Portland's Response to Review Comments letter (Port of Portland, November 12, 2001). The available groundwater monitoring data were screened against appropriate DEQ Ecological Screening Benchmark Values (SBVs) to determine whether the detected concentrations of contaminants exceeded the risk based screening levels. The Modified Level 2 Screening of groundwater data is presented in Table 12.

The groundwater monitoring well data from each well were screened against the Freshwater Aquatic SBVs. No PAHs or VOCs were detected in groundwater at concentrations exceeding their corresponding SBVs. There were two metals (lead and mercury in MW-3 and lead in MW-7) for which the total metal concentration exceeded the corresponding SBV. However, the analysis of the dissolved fraction of lead and mercury from monitoring wells MW-3 and MW-7 indicates these metals were not detected in the samples and there are no detected concentrations of analytes that exceed the SBVs. As dissolved metals represent the bioavailable fraction of metals in aqueous media, it is concluded

that there are no constituents in groundwater at levels of concern to aquatic ecological receptors.

4.5 Conclusions and Recommendations

In October 2001, Hart Crowser completed a Level 1 Scoping ERA for possible ecological receptors and pathways at the T1S Site. The site visit and historical research did not identify any ecologically important species or habitats present in the upland portion of this site. The site is almost entirely paved or covered by buildings. The absence of upland habitat results in no complete exposure pathways to terrestrial species.

A Modified Level 2 Screening ERA was conducted on the available groundwater data collected at this site. There were no detected concentrations of organic constituents in the seven groundwater monitoring wells that exceeded their corresponding Ecological SBVs. There were two metals (copper and lead) detected in groundwater that exceeded SBVs based on the analysis of unfiltered, total metals but when the same samples were analyzed for dissolved metals, copper and lead were not detected. The dissolved fraction of metals represents the bioavailable fraction in aqueous environmental media. Therefore, it is concluded that there is no potential for adverse ecological impacts to aquatic ecological receptors from the discharge of groundwater to the Willamette River.

No further ERA activities are warranted at this site.

5.0 LIMITATIONS

Hart Crowser performed this work in accordance with generally accepted professional practices related to the nature of the work accomplished, in the same or similar localities, at the time the services were performed. This report is for the specific application to the referenced project and for the exclusive use of the Port. No other warranty, express or implied, is made.

6.0 REFERENCES

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Tables

Table 1 - Area A COPC Identification Table
Marine Terminal 1 South Risk Assessment
Portland, Oregon

	Soil (Concentrations in mg/kg)						Groundwater (Concentrations in µg/L)							
	PRG	Cij	Rij	COPC?	Rij/Ri	COPC?	PRG	Cij	Rij	COPC?	Rij/Ri	COPC?	SRij	Multiple Media COPC?
Total Petroleum Hydrocarbons														
Diesel	NA	1.2E+03	--	Yes[1]	--	Yes[1]	NA	4.2E+02	--	Yes[1]	--	Yes[1]	na	No
Oil	NA	1.8E+03	--	Yes[1]	--	Yes[1]	--	ND	--	--	--	--	na	No
Semivolatiles														
Acenaphthene	3.7E+03	6.6E+00	1.8E-03	No	8.9E-06	No	3.7E+02	7.2E-01	1.9E-03	No	7.6E-04	No	3.7E-03	No
Acenaphthylene	3.7E+03	5.6E-01	1.5E-04	No	7.6E-07	No	--	ND	--	--	--	--	1.5E-04	No
Anthracene	2.2E+04	1.1E+01	5.2E-04	No	2.6E-06	No	--	ND	--	--	--	--	5.2E-04	No
Benzo(a)anthracene	6.2E-01	9.4E+00	1.5E+01	Yes	7.6E-02	Yes	--	ND	--	--	--	--	1.5E+01	Yes
Benzo(a)pyrene	6.2E-02	7.1E+00	1.1E+02	Yes	5.7E-01	Yes	--	ND	--	--	--	--	1.1E+02	Yes
Benzo(b)fluoranthene	6.2E-01	4.2E+00	6.8E+00	Yes	3.4E-02	Yes	--	ND	--	--	--	--	6.8E+00	Yes
Benzo(g,h,i)perylene	2.3E+03	3.8E+00	1.6E-03	No	8.2E-06	No	--	ND	--	--	--	--	1.6E-03	No
Benzo(k)fluoranthene	6.2E+00	5.5E+00	8.9E-01	No	4.5E-03	No	--	ND	--	--	--	--	8.9E-01	No
Chrysene	6.2E+01	9.6E+00	1.5E-01	No	7.8E-04	No	--	ND	--	--	--	--	1.5E-01	No
Dibenz(a,h)anthracene	6.2E-02	3.5E-01	5.6E+00	Yes	2.8E-02	No	--	ND	--	--	--	--	5.6E+00	Yes
Fluoranthene	2.3E+03	2.0E+01	8.5E-03	No	4.3E-05	No	--	NE	--	--	--	--	8.5E-03	No
Fluorene	2.6E+03	5.7E+00	2.2E-03	No	1.1E-05	No	--	ND	--	--	--	--	2.2E-03	No
Indeno(1,2,3-cd)pyrene	6.2E-01	3.4E+00	5.5E+00	Yes	2.7E-02	No	--	ND	--	--	--	--	5.5E+00	Yes
Naphthalene	5.6E+01	7.9E+00	1.4E-01	No	7.1E-04	No	6.2E+00	2.9E-01	4.7E-02	No	1.8E-02	No	1.9E-01	No
Phenanthrene	2.2E+04	3.5E+01	1.6E-03	No	8.0E-06	No	1.9E+03	1.3E+00	6.9E-04	No	2.7E-04	No	2.3E-03	No
Pyrene	2.3E+03	2.8E+01	1.2E-02	No	6.0E-05	No	--	ND	--	--	--	--	1.2E-02	No
Metals														
Antimony	3.1E+01	2.0E+01	6.3E-01	No	3.2E-03	No	--	ND	--	--	--	--	6.3E-01	No
Arsenic	3.9E-01	1.3E+01	3.3E+01	Yes	1.7E-01	Yes	--	NE	--	--	--	--	3.3E+01	Yes
Cadmium	3.7E+01	7.4E+00	2.0E-01	No	1.0E-03	No	--	ND	--	--	--	--	2.0E-01	No
Chromium	2.1E+02	4.3E+01	2.1E-01	No	1.0E-03	No	--	ND	--	--	--	--	2.1E-01	No
Copper	2.9E+03	2.9E+02	9.9E-02	No	5.0E-04	No	--	NE	--	--	--	--	9.9E-02	No
Lead	4.0E+02	6.2E+03	1.5E+01	Yes	7.8E-02	Yes	--	NE	--	--	--	--	1.5E+01	Yes
Mercury	2.3E+01	9.7E+00	4.1E-01	No	2.1E-03	No	--	ND	--	--	--	--	4.1E-01	No
Nickel	1.6E+03	6.4E+01	4.0E-02	No	2.0E-04	No	--	ND	--	--	--	--	4.0E-02	No
Thallium	5.2E+00	3.5E+00	6.7E-01	No	3.4E-03	No	--	ND	--	--	--	--	6.7E-01	No
Zinc	2.3E+04	3.0E+02	1.3E-02	No	6.6E-05	No	--	ND	--	--	--	--	1.3E-02	No
Volatiles														
Acetone	1.6E+03	2.2E-01	1.4E-04	No	7.1E-07	No	--	ND	--	--	--	--	1.4E-04	No
2-Butanone	7.3E+03	3.6E-02	4.7E-06	No	2.4E-08	No	--	ND	--	--	--	--	4.7E-06	No
Tetrachloroethene	--	nd	--	No	--	No	1.1E+00	2.8E+00	2.5E+00	Yes	9.8E-01	Yes	2.5E+00	Yes
Rj			2.0E+02						2.6E+00					
Nj			3.0E+01						5.0E+00					
1/Nj			3.3E-02						2.0E-01					

F:\DATA\Jobs\Port of Portland\15181-01 T-1 Risk Assessment\Tables\Tables 1-3, COPC

Notes:
[1] COPC identified based on the presence of TPH in site soils and groundwater. No PRG is available for screening.

Variables:
PRG = EPA Region 9 PRG (residential for soil, tap water for groundwater).
Cij = Maximum detected concentration of compound i in medium j.
Rij = Risk ratio for compound i in medium j (Cij/PRG); compound is a COPC if Rij is greater than 1.
Rj = Sum of risk ratios for medium j.
Nj = Number of compounds i detected in medium j.
Rij/Rj = Compound is a COPC if this ratio is greater than 1/Nj.
SRij = Summary risk ratio for compound i in all media (total Rij across all media); compound is a COPC if SRij is greater than 1.

Acronyms:
NA = Not Available.
ND = Not Detected.
NE = Not Evaluated (only volatile compounds evaluated).
-- = Not Applicable.

Table 2 - Area B COPC Identification Table
Marine Terminal 1 South Risk Assessment
Portland, Oregon

	Soil (Concentrations in mg/kg)						Groundwater (Concentrations in µg/L)							Medium
	PRG	Cij	Rij	COPC?	Rij/Rj	COPC?	PRG	Cij	Rij	COPC?	Rij/Rj	COPC?	SRij	COPC?
Total Petroleum Hydrocarbons														
Diesel	NA	1.2E+03	–	Yes[1]	–	Yes[1]	NA	4.2E+02	–	Yes[1]	–	Yes[1]	na	No
Oil	NA	1.8E+03	–	Yes[1]	–	Yes[1]	–	–	–	–	–	–	na	No
Semivolatiles														
Acenaphthene	3.7E+03	1.1E+02	2.9E-02	No	4.8E-04	No	3.7E+02	7.2E-01	1.9E-03	No	–	–	3.1E-02	No
Acenaphthylene	3.7E+03	2.6E-01	7.1E-05	No	1.2E-06	No	–	ND	–	–	–	–	7.1E-05	No
Anthracene	2.2E+04	6.8E+01	3.1E-03	No	5.2E-05	No	–	ND	–	–	–	–	3.1E-03	No
Benzo(a)anthracene	6.2E-01	1.6E+00	2.4E+00	Yes	4.1E-02	Yes	–	ND	–	–	–	–	2.4E+00	Yes
Benzo(a)pyrene	6.2E-02	2.4E+00	3.8E+01	Yes	6.3E-01	Yes	–	ND	–	–	–	–	3.8E+01	Yes
Benzo(b)fluoranthene	6.2E-01	1.5E+00	2.5E+00	Yes	4.2E-02	Yes	–	ND	–	–	–	–	2.5E+00	Yes
Benzo(g,h,i)perylene	2.3E+03	2.5E+00	1.1E-03	No	1.8E-05	No	–	ND	–	–	–	–	1.1E-03	No
Benzo(k)fluoranthene	6.2E+00	1.1E+00	1.8E-01	No	2.9E-03	No	–	ND	–	–	–	–	1.8E-01	No
Chrysene	6.2E+01	1.9E+00	3.0E-02	No	5.1E-04	No	–	ND	–	–	–	–	3.0E-02	No
Dibenz(a,h)anthracene	6.2E-02	2.5E-01	4.1E+00	Yes	6.8E-02	Yes	–	ND	–	–	–	–	4.1E+00	Yes
Fluoranthene	2.3E+03	2.9E+02	1.2E-01	No	2.1E-03	No	–	NE	–	–	–	–	1.2E-01	No
Fluorene	2.6E+03	1.7E+02	6.7E-02	No	1.1E-03	No	–	ND	–	–	–	–	6.7E-02	No
Indeno(1,2,3-cd)pyrene	6.2E-01	1.6E+00	2.5E+00	Yes	4.2E-02	Yes	–	ND	–	–	–	–	2.5E+00	Yes
Naphthalene	5.6E+01	4.0E+00	7.1E-02	No	1.2E-03	No	6.2E+00	2.9E-01	4.7E-02	No	–	–	1.2E-01	No
Phenanthrene	2.2E+04	7.0E+02	3.2E-02	No	5.3E-04	No	1.8E+03	1.3E+00	6.9E-04	No	–	–	3.3E-02	No
Pyrene	2.3E+03	1.4E+02	6.2E-02	No	1.0E-03	No	–	ND	–	–	–	–	6.2E-02	No
Metals														
Antimony	3.1E+01	7.0E-01	2.3E-02	No	3.8E-04	No	–	ND	–	–	–	–	2.3E-02	No
Arsenic	3.9E-01	3.6E+00	9.2E+00	Yes	1.5E-01	Yes	–	NE	–	–	–	–	9.2E+00	Yes
Beryllium	1.5E+02	2.3E-01	1.5E-03	No	2.6E-05	No	–	ND	–	–	–	–	1.5E-03	No
Cadmium	3.7E+01	1.3E+00	3.6E-02	No	6.1E-04	No	–	ND	–	–	–	–	3.6E-02	No
Chromium	2.1E+02	1.6E+01	7.8E-02	No	1.3E-03	No	–	ND	–	–	–	–	7.8E-02	No
Copper	2.9E+03	2.7E+01	9.3E-03	No	1.6E-04	No	–	NE	–	–	–	–	9.3E-03	No
Lead	4.0E+02	1.2E+02	3.0E-01	No	5.1E-03	No	–	NE	–	–	–	–	3.0E-01	No
Mercury	2.3E+01	1.5E-01	6.2E-03	No	1.0E-04	No	–	ND	–	–	–	–	6.2E-03	No
Nickel	1.6E+03	2.4E+01	1.5E-02	No	2.5E-04	No	–	ND	–	–	–	–	1.5E-02	No
Thallium	5.2E+00	6.1E-02	1.2E-02	No	2.0E-04	No	–	ND	–	–	–	–	1.2E-02	No
Zinc	2.3E+04	1.4E+02	6.1E-03	No	1.0E-04	No	–	ND	–	–	–	–	6.1E-03	No
Rj			6.0E+01						5.0E-02					
Nij			2.9E+01						4.0E+00					
1/Nij			3.4E-02						2.5E-01					

P:\DATA\Jobs\Port of Portland\15191-01 T-1 Risk Assessment\Tables\Tables 1-3, COPC

Notes:
[1] COPC identified based on the presence of TPH in site soils and groundwater. No PRG is available for screening.

Variables:
PRG = EPA Region 9 PRG (residential for soil, tap water for groundwater).
Cij = Maximum detected concentration of compound i in medium j.
Rij = Risk ratio for compound i in medium j (Cij/PRG); compound is a COPC if Rij is greater than 1.
Rj = Sum of risk ratios for medium j.
Nij = Number of compounds i detected in medium j.
Rij/Rj = Compound is a COPC if this ratio is greater than 1/Nij.
SRij = Summary risk ratio for compound i in all media (total Rij across all media); compound is a COPC if Srij is greater than 1.

Acronyms:
NA = Not Available.
ND = Not Detected.
NE = Not Evaluated (only volatile compounds evaluated).
– = Not Applicable.

Table 3 - Area C COPC Identification Table
Marine Terminal 1 South Risk Assessment
Portland, Oregon

	Soil (Concentrations in mg/kg)						Groundwater (Concentrations in ug/L)							
	PRG	Cij	Rij	COPC?	Rij/Rj	COPC?	PRG	Cij	Rij	COPC?	Rij/Rj	COPC?	SRij	Medium COPC?
Metals														
Arsenic	3.9E-01	1.2E+01	3.0E+01	Yes	9.9E-01	Yes	--	--	--	--	--	--	3.0E+01	Yes
Beryllium	1.5E+02	7.8E-01	5.2E-03	No	1.7E-04	No	--	--	--	--	--	--	5.2E-03	No
Cadmium	3.7E+01	1.3E+00	3.5E-02	No	1.2E-03	No	--	--	--	--	--	--	3.5E-02	No
Chromium	2.1E+02	2.6E+01	1.2E-01	No	4.0E-03	No	--	--	--	--	--	--	1.2E-01	No
Copper	2.9E+03	1.9E+01	6.6E-03	No	2.1E-04	No	--	--	--	--	--	--	6.6E-03	No
Lead	4.0E+02	1.6E+01	3.9E-02	No	1.3E-03	No	--	--	--	--	--	--	3.9E-02	No
Nickel	1.6E+03	1.9E+01	1.2E-02	No	3.9E-04	No	--	--	--	--	--	--	1.2E-02	No
Zinc	2.3E+04	7.7E+01	3.3E-03	No	1.1E-04	No	--	--	--	--	--	--	3.3E-03	No
Rj			3.0E+01						0.0E+00					
Nij			8.0E+00						0.0E+00					
1/Nij			1.3E-01						--					

F:\DATA\Jobs\Port of Portland\15191-01 T-1 Risk Assessment\Tables\Tables 1-3, COPC

Variables:
PRG = EPA Region 9 PRG (residential for soil, tap water for groundwater).
Cij = Maximum detected concentration of compound i in medium j.
Rij = Risk ratio for compound i in medium j (Cij/PRG); compound is a COPC if Rij is greater than 1.
Rj = Sum of risk ratios for medium j.
Nij = Number of compounds i detected in medium j.
Rij/Rj = Compound is a COPC if this ratio is greater than 1/Nij.
SRij = Summary risk ratio for compound i in all media (total Rij across all media); compound is a COPC if Srij is greater than 1.

Acronyms:
-- = Not Applicable.

Table 4 - Exposure Point Concentrations: Soil and Groundwater
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Analyte	Detection Frequency	SQL Range (Min-Max)	Detect Range (Min-Max)	Sample ID of Maximum Detection	Distribution	90 % UCL	Arithmetic Mean	EPC RME	EPC CT
AREA A: SURFACE SOIL (0 to 3 feet bgs)									
PAHs in mg/kg									
Benzo(a)anthracene	7/18	0.0134 - 1.0	0.0275 - 9.35	B-68	Weak Lognormal	2.0E+00	6.7E-01	2.0E+00	6.7E-01
Benzo(a)pyrene	7/18	0.0134 - 1.0	0.0292 - 7.05	B-68	Weak Lognormal	1.8E+00	5.5E-01	1.8E+00	5.5E-01
Benzo(b)fluoranthene	6/18	0.0134 - 1.0	0.0189 - 4.22	B-68	Weak Lognormal	1.4E+00	4.0E-01	1.4E+00	4.0E-01
Dibenz(a,h)anthracene	3/18	0.01 - 1.34	0.033 - 0.16	B-94	Weak Lognormal	1.8E-01	9.0E-02	1.6E-01	9.0E-02
Indeno(1,2,3-cd)pyrene	6/18	0.0134 - 1.0	0.0131 - 3.38	B-68	Weak Lognormal	7.4E-01	2.8E-01	7.4E-01	2.8E-01
Metals in mg/kg									
Arsenic	7/10	1.0	1.49 - 12.9	B-68	Lognormal	8.4E+00	3.3E+00	8.4E+00	3.3E+00
Lead	7/12	1.0 - 10.0	9.21 - 6,190	B-68	Lognormal	1.7E+04	5.4E+02	6.2E+03	5.4E+02
TPH in mg/kg									
Diesel Range	5/18	24.4 - 506	36.0 - 653	B-68	Assm. Lognormal	1.8E+02	9.7E+01	1.8E+02	9.7E+01
Oil-Range	6/18	50.0 - 61.7	72.1 - 1,300	B-94	Assm. Lognormal	3.8E+02	2.1E+02	3.8E+02	2.1E+02
AREA A: TOTAL SOIL (0 to 15 feet bgs)									
PAHs in mg/kg									
Benzo(a)anthracene	16/41	0.01 - 1.0	0.0203 - 9.35	B-68	Weak Lognormal	3.5E-01	3.7E-01	3.7E-01	3.7E-01
Benzo(a)pyrene	16/41	0.01 - 1.0	0.0157 - 7.05	B-68	Weak Lognormal	3.7E-01	3.3E-01	3.7E-01	3.3E-01
Benzo(b)fluoranthene	16/41	0.01 - 1.0	0.018 - 4.22	B-68	Weak Lognormal	3.4E-01	2.7E-01	3.4E-01	2.7E-01
Dibenz(a,h)anthracene	6/41	0.01 - 1.34	0.015 - 0.35	B-38	Weak Lognormal	7.0E-02	6.0E-02	7.0E-02	6.0E-02
Indeno(1,2,3-cd)pyrene	14/41	0.01 - 1.0	0.0131 - 3.38	B-68	Weak Lognormal	2.0E-01	1.8E-01	2.0E-01	1.8E-01
Metals in mg/kg									
Arsenic	12/15	1.0	1.35 - 12.9	B-68	Lognormal	6.0E+00	3.4E+00	6.0E+00	3.4E+00
Lead	11/18	1.0 - 10.0	2.73 - 6,190	B-68	Lognormal	5.0E+03	4.3E+02	5.0E+03	4.3E+02
TPH in mg/kg									
Diesel Range	11/53	24.4 - 506	25.5 - 1,170	B-102	Assm. Lognormal	8.7E+01	9.6E+01	9.6E+01	9.6E+01
Oil-Range	16/53	50.0 - 69.4	62.0 - 1,760	B-102	Assm. Lognormal	1.8E+02	2.0E+02	2.0E+02	2.0E+02
AREA A: GROUNDWATER									
Tetrachloroethene	1/2	1.0	2.76	MW-1	NA	2.8E+00	2.8E+00	2.8E+00	2.8E+00

Please refer to notes at end of table.

Table 4 - Exposure Point Concentrations: Soil and Groundwater
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Analyte	Detection Frequency	SQL Range (Min-Max)	Detect Range (Min-Max)	Sample ID of Maximum Detection	Distribution	90 % UCL	Arithmetic Mean	EPC	
								RME	CT
AREA B: SURFACE SOIL (0 to 3 feet bgs)									
PAHs in mg/kg									
Benzo(a)anthracene	4/7	0.0134 - 0.067	0.0448 - 0.149	B-87	Lognormal	1.7E-01	6.0E-02	1.5E-01	6.0E-02
Benzo(a)pyrene	4/7	0.0134 - 0.067	0.0501 - 0.188	B-87	Lognormal	2.1E-01	7.0E-02	1.9E-01	7.0E-02
Benzo(b)fluoranthene	4/7	0.0134 - 0.067	0.0402 - 0.134	B-64/B-64a	Lognormal	1.8E-01	6.0E-02	1.3E-01	6.0E-02
Indeno(1,2,3-cd)pyrene	4/7	0.0134 - 0.067	0.0281 - 0.117	B-64/B-64a	Lognormal	1.4E-01	5.0E-02	1.2E-01	5.0E-02
Metals in mg/kg									
Arsenic	4/4	--	2.6 - 3.1	B-31	NA	3.1E+00	2.9E+00	3.1E+00	2.9E+00
TPH in mg/kg									
Oil-Range	4/9	50.0	1,170 - 6,030	B-5	Weak Lognormal	1.6E+05	1.2E+03	6.0E+03	1.2E+03
AREA B: TOTAL SOIL (0 to 15 feet bgs)									
PAHs in mg/kg									
Benzo(a)anthracene	13/19	0.0134 - 67	0.02 - 1.51	B-92	Lognormal	1.7E+00	4.0E-01	1.5E+00	4.0E-01
Benzo(a)pyrene	13/19	0.0134 - 67	0.0246 - 2.35	B-92	Lognormal	2.1E+00	4.7E-01	2.1E+00	4.7E-01
Benzo(b)fluoranthene	13/19	0.0134 - 67	0.0215 - 1.54	B-92	Lognormal	1.4E+00	3.7E-01	1.4E+00	3.7E-01
Dibenz(a,h)anthracene	4/19	0.0134 - 67	0.0839 - 0.253	B-92	Lognormal	2.3E-01	1.1E-01	2.3E-01	1.1E-01
Indeno(1,2,3-cd)pyrene	13/19	0.0134 - 67	0.0193 - 1.56	B-92	Lognormal	9.0E-01	2.9E-01	9.0E-01	2.9E-01
Metals in mg/kg									
Arsenic	6/6	--	2.05 - 3.6	B-63/B-63a	Lognormal	3.3E+00	2.9E+00	3.3E+00	2.9E+00
TPH in mg/kg									
Diesel Range	5/30	20.8 - 2,500	29.0 - 3,440	B-63/B-63a	Assm. Lognormal	4.8E+02	2.7E+02	4.8E+02	2.7E+02
Oil-Range	16/30	50.0 - 52.1	62.7 - 20,700	B-65/B-65a	Assm. Lognormal	6.8E+03	1.7E+03	6.8E+03	1.7E+03
AREA C: SURFACE SOIL (0 to 3 feet bgs)									
Metals in mg/kg									
Arsenic	1/1	--	2.9	B-32	NA	2.9E+00	2.9E+00	2.9E+00	2.9E+00
AREA C: TOTAL SOIL (0 to 15 feet bgs)									
Metals in mg/kg									
Arsenic	3/3	--	2.72 - 11.8	B-3	NA	1.2E+01	5.8E+00	1.2E+01	5.8E+00

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Notes:

Acronyms and Abbreviations:

EPC = Exposure point concentration.
PAHs = Polynuclear aromatic hydrocarbons.
RME = Reasonable maximum exposure.
TPH = Total petroleum hydrocarbons.
UCL = Upper confidence limit on the mean.
VOCs = Volatile organic compounds.
CT = Central Tendency.
SQL = Standard quantification limit.
NA = Not applicable.

Table 5 - Exposure Dose Equations and Exposure Factor Values: Soil Ingestion
Marine Terminal 1 South Risk Assessment
Portland, Oregon

$$LADD^{a}(mg/kg\text{-}d) = \frac{C_{soil} \times IRS \times CF \times EF \times ED}{BW \times At_{carc}}$$

$$ADD^{b}(mg/kg\text{-}d) = \frac{C_{soil} \times IRS \times CF \times EF \times ED}{BW \times At_{non}}$$

EXPOSURE FACTOR (units)		RME[e] Value	CT[f] Value
C_{soil} =	Chemical concentration in soil (mg/kg)	UCL_{90}[c]	Arithmetic Mean
CF =	Conversion factor (kg/mg)	10^{-6}	10^{-6}
IRS =	Incidental Soil Ingestion Rate (mg/d)		
	Commercial Worker	100[d]	50[d]
	Utility/Excavation Worker	480[d]	100[d]
	Resident – Adult	100[d]	50[d]
	Resident – Child	400[d]	100[d]
EF =	Exposure frequency (days/year)		
	Commercial Worker	250[d]	250[d]
	Utility/Excavation Worker	9[d]	9[d]
	Resident – Adult/Child	350[d]	40[d]
ED =	Exposure duration (year)		
	Commercial Worker	25[d]	6[d]
	Utility/Excavation Worker	1[d]	0.5[d]
	Resident – Adult	30[d]	9[d]
	Resident – Child	6[d]	6[d]
BW =	Body weight (kg)		
	Adult	70[d]	70[d]
	Child	15[d]	15[d]
AT_{carc} =	Averaging time for carcinogens (days)	25,550[d]	25,550[d]
AT_{non} =	Averaging time for noncarcinogens (days)	ED (years) x 365 days/year	ED (years) x 365 days/year

F:\DATA\Jobs\Port of Portland\18191-01 T-1 Risk Assessment\Tables\Table5Soil-Ing(T1)

Notes:

[a] Lifetime average daily dose, the intake value used to evaluate potential carcinogenic effects. For the residential evaluation, the adult and child intakes will be combined as recommended in Appendix A, Section A.0 of DEQ guidance (2000).

[b] Average daily dose, the intake value used to evaluate potential noncarcinogenic effects.

[c] An upper one-sided 90 percent confidence limit of the mean or the maximum concentration (whichever is lower) used for the RME.

[d] DEQ (December 2000).

[e] Reasonable maximum exposure.

[f] Central Tendency.

Table 6 - Exposure Dose Equations and Exposure Factor Values: Dermal Contact with Soil
Marine Terminal 1 South Risk Assessment
Portland, Oregon

$$LADD^{a}\ (mg/kg\text{-}d) = \frac{C_{soil} \times AF \times SA \times DAF \times EF \times ED \times CF}{BW \times At_{carc}}$$

$$ADD^{b}\ (mg/kg\text{-}d) = \frac{C_{soil} \times AF \times SA \times DAF \times EF \times ED \times CF}{BW \times At_{non}}$$

Exposure Factor (units)	RME[e] Value	CT[f] Value
C_{soil} = Chemical concentration in soil (mg/kg)	UCL_{90}[c]	Arithmetic Mean
AF = Soil-to-skin adherence factor (mg/cm^2-event)		
Commercial Worker	0.08[d]	0.08[d]
Utility/Excavation Worker	1.0[d]	0.3[d]
Resident – Adult	0.08[d]	0.08[d]
Resident – Child	1.0[d]	0.3[d]
SA = Skin surface area (cm^2/day)		
Commercial Worker	4100[d]	3200[d]
Utility/Excavation Worker	4100[d]	3200[d]
Resident – Adult	6900[d]	5200[d]
Resident – Child	5000[d]	4500[d]
DAF = Dermal absorption factor (unitless)	Chemical-specific	Chemical-specific
EF = Exposure frequency (days/year)		
Commercial Worker	250[d]	250[d]
Utility/Excavation Worker	9[d]	9[d]
Resident – Adult/Child	350[d]	40[d]
ED = Exposure duration (years)		
Commercial Worker	25[d]	6[d]
Utility/Excavation Worker	1[d]	0.5[d]
Resident – Adult	30[d]	9[d]
Resident – Child	6[d]	6[d]
CF = Conversion factor (kg/mg)	10^{-6}	10^{-6}
BW = Body weight (kg)		
Adult	70[d]	70[d]
Child	15[d]	15[d]
AT_{carc} = Averaging time for carcinogens (days)	25,550[d]	25,550[d]
AT_{non} = Averaging time for noncarcinogens (days)	ED (years) x 365 days/year[d]	ED (years) x 365 days/year[d]

F:\DATA\Jobs\Port of Portland\15191-01.T-1 Risk Assessment\Tables\Table6Derm(T1)

Notes:
[a] Lifetime absorbed daily dose, intake value used to evaluate potential carcinogenic effects. For the residential evaluation, the adult and child intakes will be combined as recommended in Appendix A, Section A.0 of DEQ guidance (2000).
[b] Absorbed daily dose, intake value used to evaluate potential noncarcinogenic effects.
[c] An upper one-sided 90 percent confidence limit of the mean or the maximum concentration (whichever is lower) was used for the RME.
[d] DEQ (December 2000).
[e] Reasonable maximum exposure.
[f] Central Tendency.

Table 7 - Exposure Dose Equations and Exposure Factor Values: Inhalation of Volatiles
Marine Terminal 1 South Risk Assessment
Portland, Oregon

$$LADD^{a}\ (mg/kg\text{-}d) = \frac{C_{air} \times IR \times EF \times ED}{BW \times At_{carc}}$$

$$ADD^{b}\ (mg/kg\text{-}d) = \frac{C_{air} \times IR \times EF \times ED}{BW \times At_{non}}$$

Exposure Factor (units)	RME[f] Value	CT[g] Value
C_{air}[d] = Chemical concentration in air (mg/m^3)	UCL_{90}[c]	Arithmetic Mean
IR = Inhalation rate (m^3/day)		
Commercial Worker	15.2[e]	15.2[e]
Utility/Excavation Worker	15.2[e]	15.2[e]
Resident – Adult	15.2[e]	15.2[e]
Resident – Child	8.3[e]	8.3[e]
EF = Exposure frequency (days/year)		
Commercial Worker	250[e]	250[e]
Utility/Excavation Worker	9[e]	9[e]
Resident – Adult/Child	350[e]	350[e]
ED = Exposure duration (years)		
Commercial Worker	25[e]	6[e]
Utility/Excavation Worker	1[e]	0.5[e]
Resident – Adult	30[e]	9[e]
Resident – Child	6[e]	6[e]
BW = Body weight (kg)		
Adult	70[e]	70[e]
Child	15[e]	15[e]
AT_{carc} = Averaging time for carcinogens (days)	25,550[e]	25,550[e]
At_{non} = Averaging time for noncarcinogens (days)	ED (years) x 365 days/year	ED (years) x 365 days/year

F:\DATA\Jobs\Port of Portland\15191-01 T-1 Risk Assessment\Tables\Table7inhal(T1)

Notes:

[a] Lifetime average daily dose, intake value used to evaluate potential carcinogenic effects. For the residential evaluation, the adult and child intakes will be combined as recommended in Appendix A, Section A.0 of DEQ guidance (2000).

[b] Average daily dose, intake value used to evaluate potential noncarcinogenic effects.

[c] Upper one-sided 90 percent confidence limit of the mean or the maximum concentration (whichever is lower) was used for the RME.

[d] C_{air} was derived from soil and groundwater concentrations using models discussed in DEQ guidance (1999 and 2000).

[e] DEQ (December 2000).

[f] Reasonable maximum exposure.

[g] Central Tendency.

Table 8 - Exposure Dose Equations and Exposure Factor Values: Inhalation of Dust Marine Terminal 1 South Risk Assessment Portland, Oregon

$$LADD^{a}\ (mg/kg\text{-}d) = \frac{PM_{10} \times IR \times EF \times ED}{BW \times At_{carc}}$$

$$ADD^{b}\ (mg/kg\text{-}d) = \frac{PM_{10} \times IR \times EF \times ED}{BW \times At_{non}}$$

Exposure Factor (units)	RME[f] Value	CT[g] Value
PM_{10}[d] = Respirable particulate concentration in air (mg/m^3)	UCL_{90}[c]	Arithmetic Mean
IR = Inhalation rate (m^3/day)		
Commercial Worker	15.2[e]	15.2[e]
Utility/Excavation Worker	15.2[e]	15.2[e]
Resident – Adult	15.2[e]	15.2[e]
Resident – Child	8.3[e]	8.3[e]
EF = Exposure frequency (days/year)		
Commercial Worker	250[e]	250[e]
Utility/Excavation Worker	9[e]	9[e]
Resident – Adult/Child	350[e]	350[e]
ED = Exposure duration (years)		
Commercial Worker	25[e]	6[e]
Utility/Excavation Worker	1[e]	0.5[e]
Resident – Adult	30[e]	9[e]
Resident – Child	6[e]	6[e]
BW = Body weight (kg)		
Adult	70[e]	70[e]
Child	15[e]	15[e]
AT_{carc} = Averaging time for carcinogens (days)	25,550[e]	25,550[e]
At_{non} = Averaging time for noncarcinogens (days)	ED (years) x 365 days/year	ED (years) x 365 days/year

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Notes:

[a] Lifetime average daily dose, intake value used to evaluate potential carcinogenic effects. For the residential evaluation, the adult and child intakes will be combined as recommended in Appendix A, Section A.0 of DEQ guidance (2000).

[b] Averago daily dose, intake value used to evaluate potential noncarcinogenic effects.

[c] Upper one-sided 90 percent confidence limit of the mean or the maximum concentration (whichever is lower) was used for the RME.

[d] PM_{10} was derived using the Particulate Emission Factor equation presented in DEQ guidance (2000).

[e] DEQ (December 2000).

[f] Reasonable maximum exposure.

[g] Central Tendency.

Table 9 - Human Health Toxicity Assessment
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Noncarcinogenic Toxicity Values

Compound of Potential Concern	Oral RfD Citation	Oral RfD in mg/kg-day	Critical Effect	Uncertainty Factor	Inhalation RfD Citation	Inhalation RfD in mg/kg-day	Critical Effect	Uncertainty Factor
Volatile Organics								
Tetrachloroethene	IRIS	1.00E-02	Liver toxicity and weight gain	1000	NCEA/ODEQ	8.40E-02	NA	NA
Metals								
Arsenic	IRIS	3.00E-04	Hyperpigmentation, keratosis and possible vascular complications	3	NA	NA	NA	NA

Carcinogenic Toxicity Values

Compound of Potential Concern	Oral CSF Citation	Oral CSF in $(mg/kg\text{-}day)^{-1}$	Type of Cancer	Slope Factor/ Unit Risk: Weight of Evidence	Inhalation CSF Citation	Inhalation CSF in $(mg/kg\text{-}day)^{-1}$	Type of Cancer	Weight of Evidence
Volatile Organics								
Tetrachloroethene	NCEA	0.052	NA	NA	NCEA/ODEQ	2.6E-03	NA	NA
Semivolatile Organics								
Benzo(a)anthracene	IRIS	7.3E-01	see Benzo(a)pyrene	B2	NCEA	3.1E-01	NA	NA
Benzo(a)pyrene	IRIS	7.3E+00	Stomach, larynx, and esophagus	B2	NCEA	3.1E+00	NA	NA
Benzo(b)fluoranthene	IRIS	7.3E-01	see Benzo(a)pyrene	B2	NCEA	3.1E-01	NA	NA
Dibenz(a,h)anthracene	IRIS	7.3E+00	see Benzo(a)pyrene	B2	NCEA	3.1E+00	NA	NA
Indeno(1,2,3-cd)pyrene	IRIS	7.3E-01	see Benzo(a)pyrene	B2	NCEA	3.1E-01	NA	NA
Metals								
Arsenic	IRIS	1.5E+00	Skin	A	IRIS	1.5E+01	Lung	A

F:\DATA\Jobs\Port of Portland\15-81-01 T-1 Risk Assessment\Tables\Table 9 Toxicity Data

Notes:

IRIS = Integrated Risk Information System (On-line Database).
NCEA = National Center for Environmental Assessment (EPA, 2000a).
ODEQ = Oregon Department of Environmental Quality (DEQ, 2001b).
NA = Not Available or Not Applicable.
RfD = Reference Dose.
CSF = Carcinogenic slope factor.
A = Human Carcinogen.
B2 = Probable human carcinogen - based on sufficient evidence of carcinogenicity in animals.

Table 10 - Risk and Hazard Summary: By Exposure Pathway
Marine Terminal 1 South Risk Assessment
Portland, Oregon

SubArea	Exposure Scenario	RME Cancer Risk					RME Hazard Index				
		Ingestion	Dermal	Inhalation of Volatiles	Inhalation of Dust	TOTAL	Ingestion	Dermal	Inhalation of Volatiles	Inhalation of Dust	TOTAL
Area A	Resident	8.E-05	8.E-05	4.E-09	3.E-08	1.2E-04	7.E-01	3.E-01	8.E-05	0.E+00	1.E+00
	Commercial Worker	1.E-05	3.E-06	6.E-10	5.E-09	**1.E-05**	3.E-02	3.E-03	5.E-06	0.E+00	3.E-02
	Excavation Worker	3.E-08	2.E-08	1.E-13	5.E-12	**5.E-08**	3.E-03	9.E-04	3.E-08	0.E+00	4.E-03
Area B	Resident	2.E-05	1.E-05	NA	9.E-09	3.E-05	3.E-01	1.E-01	NA	0.E+00	4.E-01
	Commercial Worker	2.E-06	4.E-07	NA	2.E-09	**2.E-06**	1.E-02	1.E-03	NA	0.E+00	1.E-02
	Excavation Worker	6.E-08	6.E-08	NA	3.E-12	**1.E-07**	2.E-03	5.E-04	NA	0.E+00	3.E-03
Area C	Resident	1.E-05	4.E-06	NA	8.E-09	2.E-05	2.E-01	9.E-02	NA	0.E+00	3.E-01
	Commercial Worker	2.E-06	1.E-07	NA	2.E-09	**2.E-06**	9.E-03	9.E-04	NA	0.E+00	1.E-02
	Excavation Worker	4.E-08	1.E-08	NA	1.E-11	**5.E-08**	7.E-03	2.E-03	NA	0.E+00	9.E-03

SubArea	Exposure Scenario	CT Cancer Risk					CT Hazard Index				
		Ingestion	Dermal	Inhalation of Volatiles	Inhalation of Dust	TOTAL	Ingestion	Dermal	Inhalation of Volatiles	Inhalation of Dust	TOTAL
Area A	Resident	7.E-07	8.E-07	2.E-09	2.E-09	**2.E-06**	8.E-03	3.E-03	8.E-05	0.E+00	1.E-02
	Commercial Worker	4.E-07	2.E-07	1.E-10	5.E-10	**6.E-07**	5.E-03	8.E-04	5.E-06	0.E+00	6.E-03
	Excavation Worker	2.E-09	1.E-09	5.E-14	2.E-12	**3.E-09**	4.E-04	1.E-04	3.E-08	0.E+00	5.E-04
Area B	Resident	3.E-07	2.E-07	NA	2.E-09	**5.E-07**	7.E-03	3.E-03	NA	0.E+00	1.E-02
	Commercial Worker	2.E-07	5.E-08	NA	4.E-10	**3.E-07**	5.E-03	7.E-04	NA	0.E+00	6.E-03
	Excavation Worker	2.E-09	2.E-09	NA	1.E-12	**4.E-09**	3.E-04	1.E-04	NA	0.E+00	4.E-04
Area C	Resident	3.E-07	1.E-07	NA	2.E-09	**4.E-07**	7.E-03	3.E-03	NA	0.E+00	1.E-02
	Commercial Worker	2.E-07	3.E-08	NA	4.E-10	**2.E-07**	5.E-03	7.E-04	NA	0.E+00	6.E-03
	Excavation Worker	2.E-09	6.E-10	NA	3.E-12	**3.E-09**	7.E-04	2.E-04	NA	0.E+00	9.E-04

F:\DATA\Jobs\Port of Portland\15181-01 T-1 Risk Assessment\Tables\Table 10 and 11 Risk Sum

Note:
1. Shaded boxes indicate exposure scenaros that exceed DEQ's acceptable risk targets.

Table 11 - RME Risk Summary: By COPC
Marine Terminal 1 South Risk Assessment
Portland, Oregon

SubArea	Exposure Scenario	COPC	RME Cancer Risk				
			Ingestion	Dermal	Inhalation of Volatiles	Inhalation of Dust	TOTAL
Area A	Resident	Benzo(a)anthracene	4.E-06	6.E-06	na	1.E-10	1.E-05
		Benzo(a)pyrene	4.E-05	5.E-05	na	1.E-09	9.E-05
		Benzo(b)fluoranthene	3.E-06	4.E-06	na	8.E-11	7.E-06
		Dibenz(a,h)anthracene	3.E-06	5.E-06	na	1.E-10	8.E-06
		Indeno(1,2,3-cd)pyrene	1.E-06	2.E-06	na	4.E-11	3.E-06
		Arsenic	3.E-05	1.E-05	na	2.E-08	5.E-05
		Tetrachloroethene	na	na	4.E-09	na	4.E-09
		TOTAL	**8.E-05**	**8.E-05**	**4.E-09**	**3.E-08**	**2.E-04**
	Commercial Worker	Benzo(a)anthracene	5.E-07	2.E-07	na	3.E-11	7.E-07
		Benzo(a)pyrene	5.E-06	2.E-06	na	2.E-10	7.E-06
		Benzo(b)fluoranthene	4.E-07	2.E-07	na	2.E-11	5.E-07
		Dibenz(a,h)anthracene	4.E-07	2.E-07	na	2.E-11	6.E-07
		Indeno(1,2,3-cd)pyrene	2.E-07	8.E-08	na	9.E-12	3.E-07
		Arsenic	4.E-06	4.E-07	na	5.E-09	5.E-06
		Tetrachloroethene	na	na	6.E-10	na	6.E-10
		TOTAL	**1.E-05**	**3.E-06**	**6.E-10**	**5.E-09**	**1.E-05**
Area B	Resident	Benzo(a)anthracene	3.E-07	4.E-07	na	9.E-12	7.E-07
		Benzo(a)pyrene	4.E-06	5.E-06	na	1.E-10	9.E-06
		Benzo(b)fluoranthene	3.E-07	4.E-07	na	8.E-12	6.E-07
		Indeno(1,2,3-cd)pyrene	2.E-07	3.E-07	na	7.E-12	6.E-07
		Arsenic	1.E-05	4.E-06	na	9.E-09	2.E-05
		TOTAL	**2.E-05**	**1.E-05**	**na**	**9.E-09**	**3.E-05**
	Commercial Worker	Benzo(a)anthracene	4.E-08	2.E-08	na	2.E-12	5.E-08
		Benzo(a)pyrene	5.E-07	2.E-07	na	2.E-11	7.E-07
		Benzo(b)fluoranthene	3.E-08	1.E-08	na	2.E-12	5.E-08
		Indeno(1,2,3-cd)pyrene	3.E-08	1.E-08	na	2.E-12	4.E-08
		Arsenic	2.E-06	2.E-07	na	2.E-09	2.E-06
		TOTAL	**2.E-06**	**4.E-07**	**na**	**2.E-09**	**3.E-06**
Area C	Resident	Arsenic	1.E-05	4.E-06	na	8.E-09	2.E-05
	Commercial Worker	Arsenic	2.E-06	2.E-07	na	2.E-09	2.E-06

F:\DATA\Jobs\Port of Portland\15191-01 T-1 Risk Assessment\Tables\Table 10 and 11 Risk Sum

Note:

1. Shaded boxes indicate COPC that exceeds DEQ acceptable risk target.

Table 12 - Modified Level 2 Screening of Groundwater Results
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Station Sampling Date	MW-1 10/01/2001	MW-2 10/01/2001	MW-3 9/28/2001	MW-4 9/28/2001	MW-5 9/28/2001	MW-6 9/28/2001	MW-7 10/01/2001	DEQ SBV Aquatic
Total Metals in µg/L								
Arsenic	2.01	12.8	14	6.45	12.1	2.72	1.38	150
Cadmium	1 U	NA	NA	1 U	NA	NA	NA	2.2
Chromium	3.25	NA	NA	5.12	NA	NA	NA	74
Copper	4.74	2 U	4.02	4.48	2.95	2.61	2 U	9
Lead	1.16	1 U	1.03	2.49	1.46	1 U	1.07	2.5
Mercury	0.2 U	NA	NA	0.2 U	NA	NA	NA	0.77
Nickel	5.25	NA	NA	3.86	NA	NA	NA	52
Silver	1 U	NA	NA	1 U	NA	NA	NA	0.12
Zinc	10.8	NA	NA	9.06	NA	NA	11.6	120
Dissolved Metals in µg/L								
Arsenic	1 U	14.5	11	6.51	11.3	3.65	1 U	150
Copper	2.29	2 U	2 U	2 U	2 U	2 U	2 U	9
Lead	1.37	1 U	1 U	1 U	1 U	1 U	1 U	2.5
PAHs in µg/L								
Benzo(a)anthracene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.027
Benzo(a)pyrene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.014
Benzo(b)fluoranthene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	--
Benzo(k)fluoranthene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	--
Chrysene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	--
Dibenz(ah)anthracene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	--
Indeno(1,2,3-cd)pyrene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	--
Acenaphthene	0.1 U	0.121	0.192	0.72	0.448	0.1 U	0.1 U	520
Acenaphthylene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	--
Anthracene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	13
Benzo(ghi)perylene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	--
Fluoranthene	0.1 U	0.119	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	6.2
Fluorene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	3.9
Naphthalene	0.1 U	0.1 U	0.1 U	0.291	0.1 U	0.1 U	0.1 U	620
Phenanthrene	0.1 U	1.25	0.138	0.576	1.16	0.1 U	0.153	6.3
Pyrene	0.1 U	0.564	0.1 U	0.123	0.172	0.1 U	0.153	--
Total PAHs	0.2 U	2.054	0.33	1.71	1.78	0.2 U	0.306	--
Volatiles in µg/L								
Benzene	1 U	NA	NA	1 U	NA	NA	NA	130
DEHP	10 U	10 U	NA	NA	NA	NA	10 U	3
Ethylbenzene	1 U	NA	NA	1 U	NA	NA	NA	7.3
PCE	2.76	NA	NA	1 U	NA	NA	NA	840
Toluene	1 U	NA	NA	1 U	NA	NA	NA	9.8
Total xylenes	1 U	NA	NA	1 U	NA	NA	NA	13

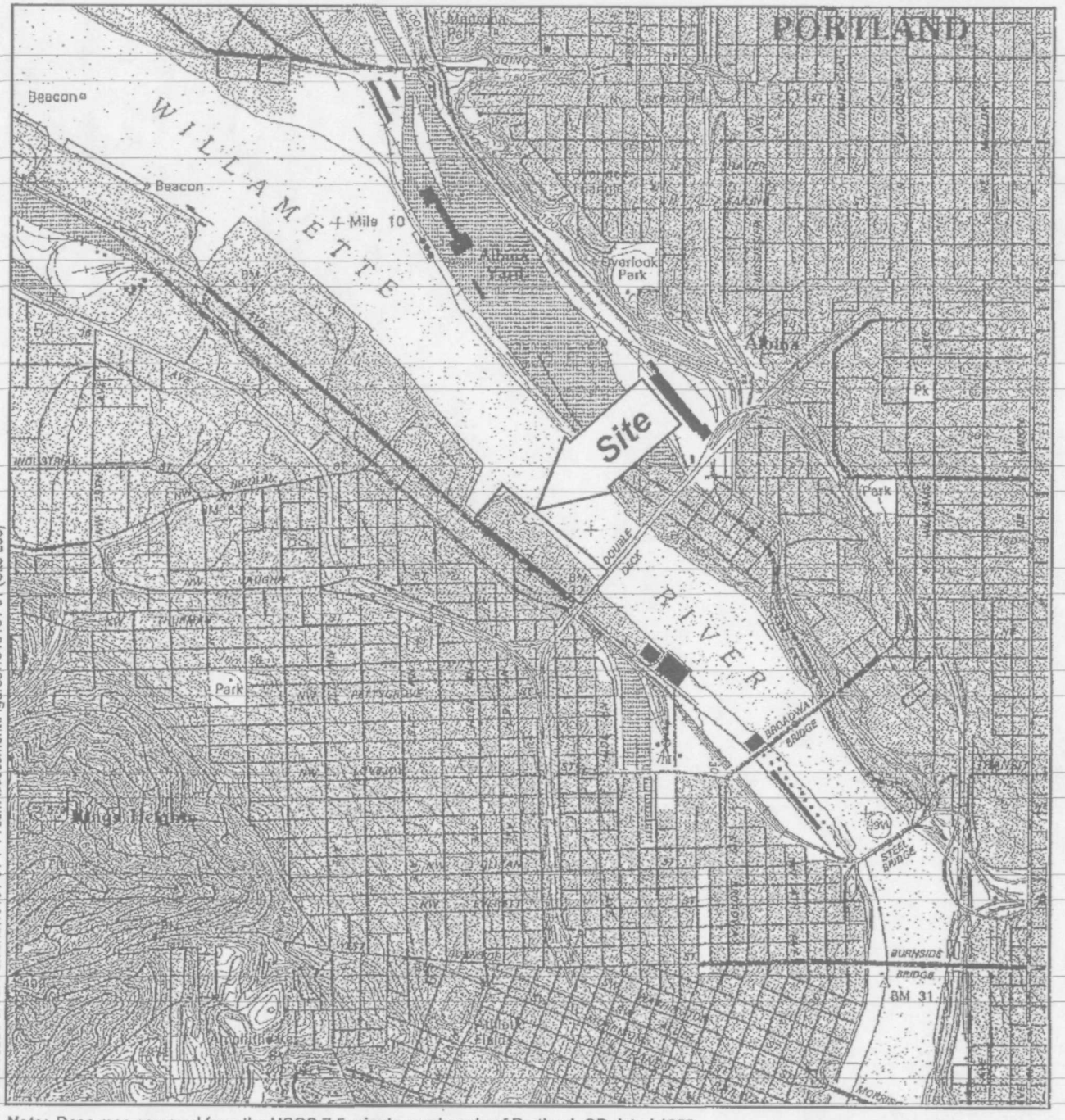
P:\DATA\Local\Port of Portland\15191-01 T-1 Risk Assessment\Tables\Tables 12-15

Notes:

1. U = Not Detected at Reported Detection Limit.
2. NA = Not Analyzed.
3. Shading Denotes Analyte Exceeding Ecological Screening Benchmark Value.
4. DEQ Ecological Screening Benchmark Value - Freshwater Value for Aquatic Organisms (DEQ March 2001).

Figures

Site Location Map
Terminal 1 South Risk Assessment
Port of Portland, Portland, Oregon



DATA\Jobs\Port of Portland\15191-01 T-1 Risk Assessment\Figures\15191101 01 (Site Loc)

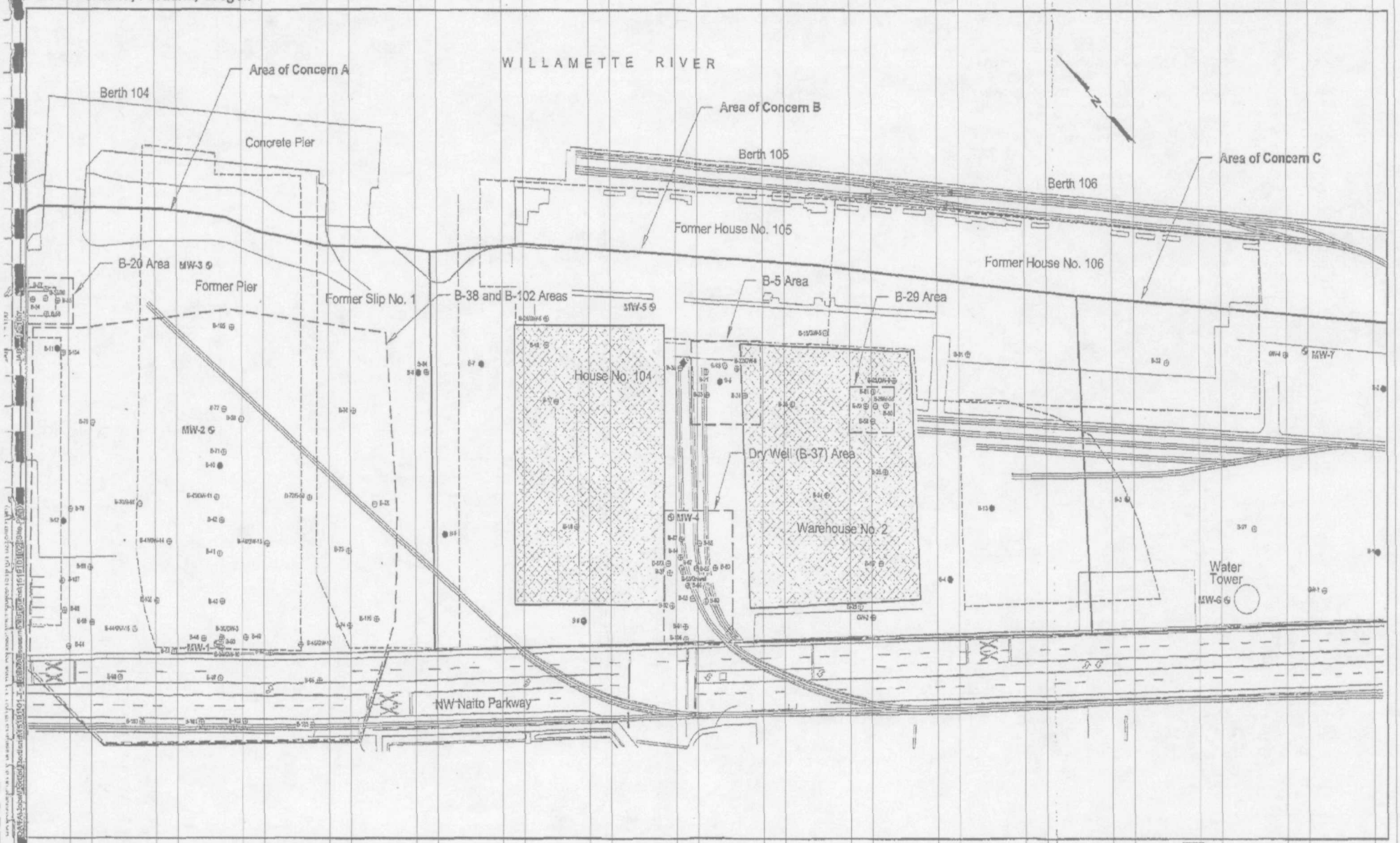
Note: Base map prepared from the USGS 7.5-minute quadrangle of Portland, OR dated 1990.

HARTCROWSER

15191-01 *1/02*

Figure 1

Site Plan
Terminal 1 South Risk Assessment
Port of Portland, Portland, Oregon



Note: Base map prepared from an AutoCAD file provided by Olson Engineering, 8/27/01.

Legend:

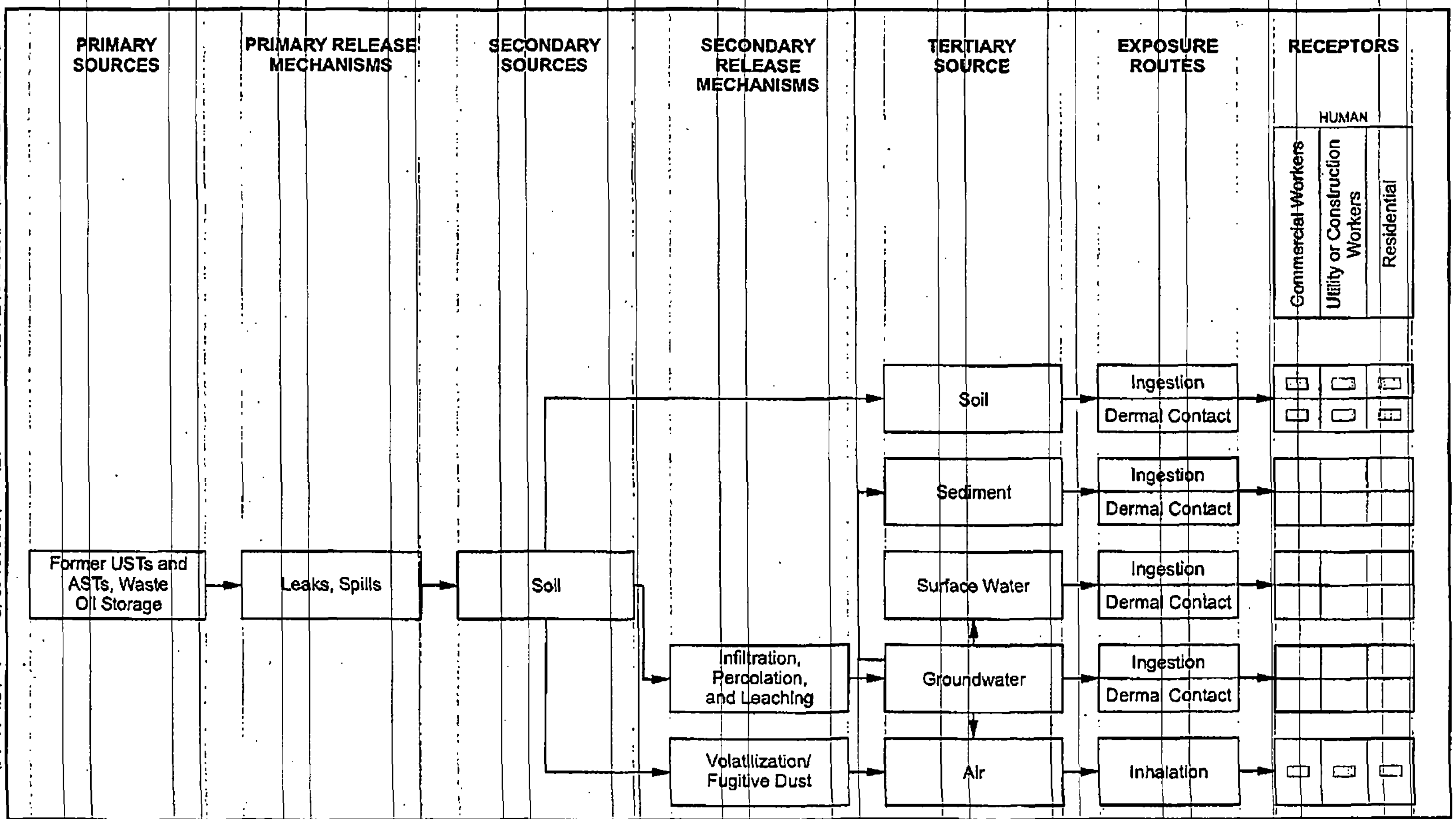
- B-4 ● Maul Foster and Alongi, Inc. Push Probe Boring Location and Number (March 1998)
- MW-1 ⊖ HAI Monitoring Well Location and Number (2001)
- B-6 ⊖ HAI Push Probe Boring Location and Number (2000)

0 100 200
Approximate Scale in Feet

HARTCROWSER
15191-00 12/01
Figure 2

POPT1S601164

Human Health Conceptual Site Model
Terminal 1 South Risk Assessment
Port of Portland, Portland, Oregon



DATA\Jobs\Port of Portland\15191-01 T-1 Risk Assessment\Figures\1519101 03 (Conceptual Site Model)

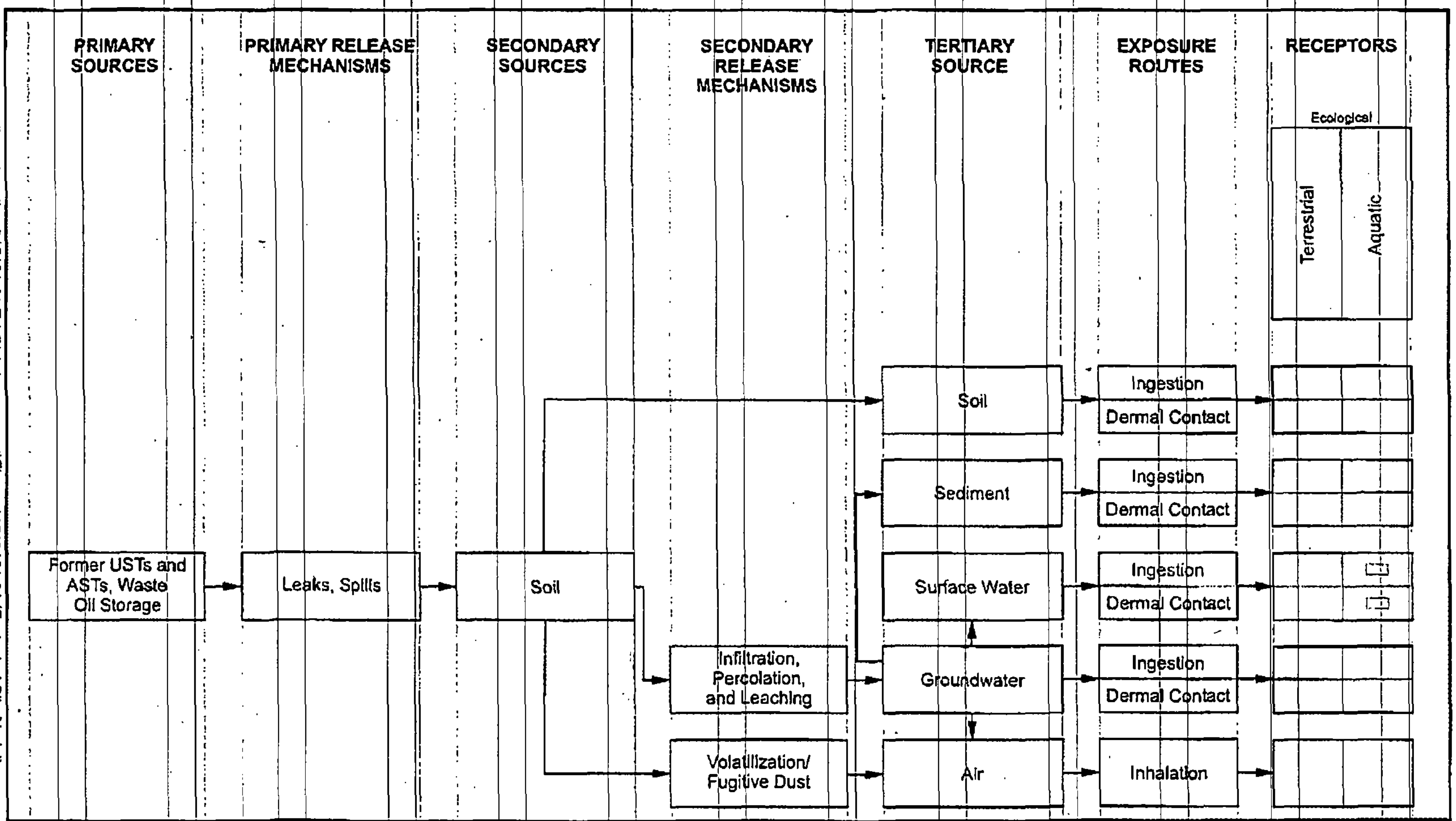
Legend:

▭ Potentially Complete Pathway

HARTCROWSER
15191-01 1/02
Figure 3

POPT1S601165

Ecological Conceptual Site Model
Terminal 1 South Risk Assessment
Port of Portland, Portland, Oregon



DATA\Jobs\Port of Portland\15191-01 T-1 Risk Assessment\Figures\1519101 04 (Ecological Site Model)

Legend:

⬚ Potentially Complete Pathway

HARTCROWSER
15191-01 *1/02*
Figure 4

POPT1S601166

Appendix A

APPENDIX A
SOIL AND GROUNDWATER ANALYTICAL DATA USED FOR THE RISK ASSESSMENTS

Table A-1 - Analytical Results for Soil Samples (Metals and PAHs)

Area	A	A	A	A	A	A	A	A	A	A	A	A	A
Sample ID	5105-001027-070	5106-001027-068	5106-001026-064	5106-001026-060	5106-001027-074	5106-001030-079	5105-001027-078	5106-001027-067	5105-001026-057	B11 (9-11)	5106-001026-056	4876-000301-020	4876-000313-037
Station	B-100	B-100	B-101	B-102	B-103	B-104	B-105	B-107	B-108	B-11	B-110	B-38	B-40
Sampling Date	10/27/2000	10/27/2000	10/26/2000	10/26/2000	10/27/2000	10/30/2000	10/27/2000	10/27/2000	10/26/2000	3/26/98	10/26/2000	3/01/2000	3/13/2000
Depth in Feet	10	2.5	10	10	10	2.5	2.5	4	2.5	9-11	2.5	10	5
Metals in mg/kg													
Antimony										0.5 UJ			
Arsenic						1.64	1 U	1.35	1.49	11.2 J	1 U		
Beryllium										0.5 U			
Cadmium										1.33		0.2 U	
Chromium										28.4		22.3	
Copper										17.1			
Lead						28.1	1 U	2.73	17.1	23.8	1 U	807	
Mercury										0.05 U			
Nickel										15.2			
Selenium										0.5 U			
Silver										1 U			
Thallium										0.5 U			
Zinc										70.5			
TCLP-Lead													
PAHs in mg/kg													
Benzo(a)anthracene	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.05 U	0.09		1 U	0.472 J	0.076
Benzo(a)pyrene	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.05 U	0.135		1 U	0.743 J	0.086
Benzo(b)fluoranthene	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.055	0.14		1 U	1.57 J	0.096
Benzo(k)fluoranthene	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.05 U	0.055		1 U	0.01 UJ	0.025
Chrysene	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.05 U	0.075		1 U	2.18 J	0.102
Dibenz(ah)anthracene	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.05 U	0.05 U		1 U	0.35 J	0.015
Indeno(1,2,3-cd)pyrene	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.05 U	0.105		1 U	0.676 J	0.052
Acenaphthene	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.05 U	0.05 U		1 U	0.63 J	0.022
Acenaphthylene	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.05 U	0.05 U		1 U	0.35 J	0.021
Anthracene	0.05 U	0.05 U	0.05 U	0.06	0.05 U			0.05 U	0.05 U		1 U	0.883 J	0.028
Benzo(ghi)perylene	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.05 U	0.165		1 U	1.28 J	0.067
Fluoranthene	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.09	0.31		1 U	0.938 J	0.139
Fluorene	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.05 U	0.05 U		1 U	0.923 J	0.013
Naphthalene	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.05 U	0.05 U		1 U	0.957 J	0.013
Phenanthrene	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U			0.05 U	0.165		1 U	2.35 J	0.104
Pyrene	0.05 U	0.05 U	0.05 U	0.075	0.05 U			0.05 U	0.37		1 U	2.83 J	0.209
Total PAHs	0.05 U	0.05 U	0.05 U	0.135	0.05 U			0.145	1.61		1 U	17.132	1.068

Please refer to notes at end of table.

Table A-1 - Analytical Results for Soil Samples (Metals and PAHs)

Area	A	A	A	A	A	A	A	A	A	A	A	A	A
Sample ID	4876-000313-043	4876-000313-056	4876-000316-067	4876-000316-071	4876-000316-079	5106-000921-044	5106-000921-050	B-68-Duplicate	5106-000921-049	5106-000921-053	5106-000921-052	5106-000921-057	5106-000921-056
Station	B-41	B-44	B-46	B-47	B-48	B-53	B-68	B-68	B-68	B-69	B-69	B-70	B-70
Sampling Date	3/13/2000	3/13/2000	3/16/2000	3/16/2000	3/16/2000	9/21/2000	9/21/2000	9/21/2000	9/21/2000	9/21/2000	9/21/2000	9/21/2000	9/21/2000
Depth in Feet	5	10	12.5	2.5	11	1	10	10	2.5	10	2.5	10	2.5
Metals in mg/kg													
Antimony						0.5 U			19.5				
Arsenic						1.82			12.9				
Beryllium						0.5 U			0.5 U				
Cadmium						0.5 U			7.43				
Chromium						14.8			43.2				
Copper						13.3			286				
Lead						10 U			6190		10 U		
Mercury						0.1 U			9.68				
Nickel						13.7			64.3				
Selenium						0.5 U			0.5 U				
Silver						1 U			1 U				
Thallium						0.5 U			3.5				
Zinc						54.2			295				
TCLP-Lead									6.62				
PAHs in mg/kg													
Benzo(a)anthracene	0.062	0.01 U	0.074	0.227	0.139 R	0.444	0.139	0.139	9.35	0.0268 U	0.0134 U	0.11	0.0268 U
Benzo(a)pyrene	0.068	0.01 U	0.096	0.243	0.169 R	0.419	0.134	0.134	7.05	0.0268 U	0.0134 U	0.118	0.0268 U
Benzo(b)fluoranthene	0.069	0.018	0.084	0.242	0.204 R	0.224	0.131	0.131	4.22	0.0268 U	0.0134 U	0.063	0.0268 U
Benzo(k)fluoranthene	0.019	0.01 U	0.023	0.082	0.047 R	0.349	0.104	0.104	5.53	0.0268 U	0.0134 U	0.083	0.0268 U
Chrysene	0.08	0.021	0.073	0.258	0.198 R	0.55	0.18	0.18	9.56	0.0309	0.0134 U	0.129	0.0268 U
Dibenz(ah)anthracene	0.015 U	0.01 U	0.014 U	0.033	0.035 R	0.0894	0.0268 U	0.0268 U	1.34 U	0.0268 U	0.0134 U	0.0176	0.0268 U
Indeno(1,2,3-cd)pyrene	0.034	0.01 U	0.042	0.113	0.117 R	0.233	0.0873	0.039	3.38	0.0268 U	0.0134 U	0.0778	0.0268 U
Acenaphthene	0.053	0.01 U	0.014 U	0.026	0.01 UR	0.0268 U	0.0268 U	0.0268 U	6.58	0.0268 U	0.0134 U	0.024	0.0268 U
Acenaphthylene	0.015 U	0.01 U	0.015	0.046	0.05 R	0.114	0.0268 U	0.0268 U	1.34 U	0.0268 U	0.0134 U	0.0592	0.0268 U
Anthracene	0.031	0.01 U	0.019	0.067	0.032 R	0.117	0.0523	0.0268 U	11.4	0.0268 U	0.0134 U	0.0563	0.0268 U
Benzo(ghi)perylene	0.049	0.01	0.058	0.16	0.171 R	0.27	0.115	0.115	3.76	0.0268 U	0.0134 U	0.111	0.0268 U
Fluoranthene	0.169	0.025	0.101	0.371	0.219 R	0.438	0.197	0.102	19.5	0.0274	0.0134 U	0.204	0.0268 U
Fluorene	0.044	0.01 U	0.014 U	0.034	0.015 R	0.0268 U	0.0268 U	0.0268 U	5.72	0.0268 U	0.0134 U	0.0167	0.0268 U
Naphthalene	0.034	0.015	0.026	0.082	0.082 R	0.0268 U	0.0268 U	0.0268 U	7.9	0.0268 U	0.0134 U	0.0151	0.0268 U
Phenanthrene	0.178	0.037	0.048	0.235	0.021 R	0.147	0.169	0.0633	34.8	0.03	0.0134 U	0.267	0.0268 U
Pyrene	0.195	0.028	0.151	0.536	0.293 R	0.857	0.253	0.101	27.6	0.0548	0.0134 U	0.416	0.0268 U
Total PAHs	1.085	0.154	0.81	2.755	1.991 R	4.2514	1.5616	1.1083	156.35	0.1431	0.0134 U	1.7677	0.0268 U

Please refer to notes at end of table.

Table A-1 - Analytical Results for Soil Samples (Metals and PAHs)

Area	A	A	A	A	A	A	A	A	A	A	A	A	A
Sample ID	5106-000921-061	5106-000921-060	5106-000921-064	5106-000921-063	5106-000921-067	5106-000921-066	5106-000925-080	5106-000925-079	5106-001027-077	B8 (9-11)	5106-000921-069	5106-000921-076	5106-000921-075
Station	B-71	B-71	B-72	B-72	B-73	B-73	B-74	B-74	B-76a	B-8	B-80	B-81	B-81
Sampling Date	9/21/2000	9/21/2000	9/21/2000	9/21/2000	9/21/2000	9/21/2000	9/25/2000	9/25/2000	10/27/2000	3/26/98	9/21/2000	9/22/2000	9/22/2000
Depth in Feet	10	2.5	12.5	2.5	12.5	2.5	12.5	2.5	2.5	9-11	10	10	2.5
Metals in mg/kg													
Antimony										0.5 UJ	0.5 U		
Arsenic									1 U	1.42 J	2.51		
Beryllium										0.5 U	0.5 U		
Cadmium										0.5 U	1.62		
Chromium										14.3	13.7		
Copper										9.34	21.3		
Lead									1 U	10 U	387		16.1
Mercury										0.05 U	0.105		
Nickel										13.8	17.7		
Selenium										0.5 U	0.5 U		
Silver										1 U	1 U		
Thallium										0.5 U	0.5 U		
Zinc										35.2	120		
TCLP-Lead													
PAHs in mg/kg													
Benzo(a)anthracene	0.0203	0.0134 U	0.0268 U	0.0275	0.0134 U	0.0134 U	0.01 U	0.0292	0.05 U			1.76	0.0268 U
Benzo(a)pyrene	0.0157	0.0134 U	0.0268 U	0.0353	0.0134 U	0.0134 U	0.01 U	0.0292	0.05 U			1.88	0.0268 U
Benzo(b)fluoranthene	0.0134 U	0.0134 U	0.0268 U	0.0268 U	0.0134 U	0.0134 U	0.01 U	0.0189	0.05 U			1.09	0.0268 U
Benzo(k)fluoranthene	0.0134 U	0.0134 U	0.0268 U	0.0268 U	0.0134 U	0.0134 U	0.01 U	0.0226	0.05 U			1.4	0.0268 U
Chrysene	0.0223	0.0134 U	0.0268 U	0.0327	0.0134 U	0.0134 U	0.01 U	0.027	0.05 U			2.06	0.0268 U
Dibenz(ah)anthracene	0.0134 U	0.0134 U	0.0268 U	0.0268 U	0.0134 U	0.0134 U	0.01 U	0.01 U	0.05 U			0.335 U	0.0268 U
Indeno(1,2,3-cd)pyrene	0.0134 U	0.0134 U	0.0268 U	0.0268 U	0.0134 U	0.0134 U	0.01 U	0.0131	0.05 U			1.09	0.0268 U
Acenaphthene	0.0134 U	0.0134 U	0.0268 U	0.0268 U	0.0134 U	0.0134 U	0.01 U	0.01 U	0.05 U			0.394	0.0268 U
Acenaphthylene	0.0134 U	0.0134 U	0.0268 U	0.0268 U	0.0134 U	0.0134 U	0.01 U	0.01 U	0.05 U			0.557	0.0268 U
Anthracene	0.0134 U	0.0134 U	0.0268 U	0.0268 U	0.0134 U	0.0134 U	0.01 U	0.01 U	0.05 U			1.07	0.0268 U
Benzo(ghi)perylene	0.0134 U	0.0134 U	0.0268 U	0.0389	0.0134 U	0.0134 U	0.01 U	0.016	0.05 U			1.35	0.0268 U
Fluoranthene	0.0237	0.0134 U	0.0268 U	0.0543	0.0134 U	0.0134 U	0.01 U	0.0576	0.05 U			4.56	0.0268 U
Fluorene	0.0134 U	0.0134 U	0.0268 U	0.0268 U	0.0134 U	0.0134 U	0.01 U	0.01 U	0.05 U			0.378	0.0268 U
Naphthalene	0.0134 U	0.0134 U	0.0268 U	0.0268 U	0.0134 U	0.0134 U	0.01 U	0.01 U	0.05 U			0.335 U	0.0268 U
Phenanthrene	0.0175	0.0134 U	0.0268 U	0.0505	0.0134 U	0.0134 U	0.01 U	0.0241	0.05 U			4.85	0.0268 U
Pyrene	0.0388	0.0134 U	0.0268 U	0.0896	0.0134 U	0.0134 U	0.01 U	0.0663	0.05 U			4.39	0.0268 U
Total PAHs	0.1383	0.0134 U	0.0268 U	0.3288	0.0134 U	0.0134 U	0.01 U	0.304	0.05 U			26.809	0.0268 U

Please refer to notes at end of table.

Table A-1 - Analytical Results for Soil Samples (Metals and PAHs)

Area	A	A	A	A	A	A	A	A	A	B	B	B	B
Sample ID	5106-000921-071	5106-000921-070	5106-001030-082	5106-001030-081	5106-001106-097	5106-001106-095	5106-001106-096	5106-001106-092	5106-001106-090	5106-001024-008	4876-000229-002	4876-000229-003	4876-000302-027
Station	B-82	B-82	B-94	B-94	B-97	B-97	B-97	B-99	B-99	B-106	B-14	B-15	B-31
Sampling Date	9/22/2000	9/22/2000	10/30/2000	10/30/2000	11/06/2000	11/06/2000	11/06/2000	11/06/2000	11/06/2000	10/24/2000	2/29/2000	2/29/2000	3/02/2000
Depth in Feet	10	2.5	10	2.5	10	3	5	10	3	7	1	2	1
Metals in mg/kg													
Antimony	0.532										2.5 UJ	2.5 UJ	2.5 UJ
Arsenic	1.76			2.44		7.53			3.73		2.9	2.9	3.1
Beryllium	0.5 U										0.23	0.23	0.21
Cadmium	0.5 U										0.2 U	0.2 U	0.2 U
Chromium	12.5										13.7	15	14.2
Copper	12										14.4	14.3	15.1
Lead	10 U			192		22.4			9.21		2.8	9.9	2.9
Mercury	1.53 J										0.1 U	0.1 U	0.1 U
Nickel	14.4										17.3	16.1	15.3
Selenium	0.5 U										1 U	1 U	1 U
Silver	1 U										0.3 U	0.3 U	0.3 U
Thallium	0.5 U										0.5 U	0.5 U	0.5 U
Zinc	45.1										43.7	46.1	39.3
TCLP-Lead													
PAHs in mg/kg													
Benzo(a)anthracene	0.067 U	0.067 U	0.13	1.26	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.132			
Benzo(a)pyrene	0.067 U	0.067 U	0.185	1.36	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.167			
Benzo(b)fluoranthene	0.067 U	0.067 U	0.21	1.7	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.1			
Benzo(k)fluoranthene	0.067 U	0.067 U	0.065	0.57	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.101			
Chrysene	0.067 U	0.067 U	0.13	1.31	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.147			
Dibenz(ah)anthracene	0.067 U	0.067 U	0.05 U	0.16	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.067 U			
Indeno(1,2,3-cd)pyrene	0.067 U	0.067 U	0.11	0.55	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.0891			
Acenaphthene	0.067 U	0.067 U	0.5 U	0.19	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.067 U			
Acenaphthylene	0.067 U	0.067 U	0.05 U	0.12	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.067 U			
Anthracene	0.067 U	0.067 U	0.05 U	0.55	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.067 U			
Benzo(ghi)perylene	0.067 U	0.067 U	0.165	0.79	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.118			
Fluoranthene	0.067 U	0.067 U	0.295	2.22	0.05 U	0.05 U	0.06	0.05 U	0.05 U	0.209			
Fluorene	0.067 U	0.067 U	0.05 U	0.135	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.067 U			
Naphthalene	0.067 U	0.067 U	0.5 U	0.13	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.067 U			
Phenanthrene	0.067 U	0.067 U	0.13	1.9	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.126			
Pyrene	0.067 U	0.067 U	0.35	2.86	0.05 U	0.05 U	0.055	0.05 U	0.05 U	0.285			
Total PAHs	0.067 U	0.067 U	1.77	15.805	0.05 U	0.05 U	0.115	0.05 U	0.05 U	1.4741			

Please refer to notes at end of table.

Table A-1 - Analytical Results for Soil Samples (Metals and PAHs)

Area	B	B	B	B	B	B	B	B	B	B	B	B	B
Sample ID	5106-000918-001	5106-000919-018	5106-000920-023	5106-001024-039	5106-001024-037	5106-001024-046	5106-001024-043	5106-001024-049	5106-001024-047	5106-001030-085	5106-001030-085	5106-001024-032	5106-001024-027
Station	B-52	B-58	B-63/63a	B-64/64a	B-64/64a	B-65/65a	B-65/65a	B-66/66a	B-66/66a	B-67/67a	B-67/67a	B-87	B-88
Sampling Date	9/19/2000	9/19/2000	9/20/2000	10/25/2000	10/25/2000	10/25/2000	10/25/2000	10/25/2000	10/25/2000	10/30/2000	10/30/2000	10/25/2000	10/25/2000
Depth in Feet	2	4	10.5	10	2.5	12	2.5	10	2.5	13.5	5.5	2.5	6.5
Metals in mg/kg													
Antimony	0.5 U	0.5 U	0.703										
Arsenic	2.6	2.05	3.6										
Beryllium	0.5 U	0.5 U	0.5 U										
Cadmium	1.34	0.584	0.703										
Chromium	16.4	11.2	6.97										
Copper	27.1	11	16.4										
Lead	121	10 U	92										
Mercury	0.128	0.1 U	0.145										
Nickel	23.5	16	12										
Selenium	0.0613	0.5 U	0.5 U										
Silver	1 U	1 U	1 U										
Thallium	0.5 U	0.5 U	0.5 U										
Zinc	140	41.5	107										
TCLP-Lead													
PAHs in mg/kg													
Benzo(a)anthracene	0.0448	0.02	67 U	0.403	0.0524	1.68 U	0.067 U	1.18	0.067 U	0.825	0.05 U	0.149	1.51
Benzo(a)pyrene	0.0501	0.0246	67 U	0.605	0.0834	1.68 U	0.067 U	1.16	0.067 U	0.92	0.05 U	0.188	1.45
Benzo(b)fluoranthene	0.0402	0.0215	67 U	0.4	0.134	1.68 U	0.067 U	1.28	0.067 U	0.82	0.05 U	0.116	0.902
Benzo(k)fluoranthene	0.0471	0.0177	67 U	0.334	0.0934	1.68 U	0.067 U	0.844	0.067 U	0.315	0.05 U	0.114	0.919
Chrysene	0.0666	0.0229	67 U	0.465	0.0798	1.88	0.067 U	1.58	0.067 U	0.67	0.05 U	0.163	1.57
Dibenz(ah)anthracene	0.0268 U	0.0134 U	67 U	0.0839	0.0268 U	1.68 U	0.067 U	0.22	0.067 U	0.05 U	0.05 U	0.067 U	0.247
Indeno(1,2,3-cd)pyrene	0.0375	0.0193	67 U	0.384	0.117	1.68 U	0.067 U	0.718	0.067 U	0.325	0.05 U	0.102	0.69
Acenaphthene	0.0268 U	0.0134 U	106	0.0754	0.0268 U	1.68 U	0.067 U	0.516	0.067 U	0.05 U	0.05 U	0.067 U	0.067 U
Acenaphthylene	0.0314	0.0134 U	67 U	0.0765	0.0268 U	1.68 U	0.067 U	0.263	0.067 U	0.05 U	0.05 U	0.067 U	0.067 U
Anthracene	0.0268 U	0.0134 U	67.8	0.136	0.0268 U	1.68 U	0.067 U	0.464	0.067 U	0.185	0.05 U	0.067 U	0.156
Benzo(ghi)perylene	0.0536	0.0262	67 U	0.564	0.174	1.68 U	0.067 U	0.837	0.067 U	0.405	0.05 U	0.136	0.88
Fluoranthene	0.0977	0.037	285	1	0.0904	1.68 U	0.067 U	4.5	0.067 U	0.72	0.05 U	0.219	1.5
Fluorene	0.0268 U	0.0134 U	174	0.067 U	0.0268 U	1.68 U	0.067 U	0.974	0.067 U	0.05 U	0.05 U	0.067 U	0.067 U
Naphthalene	0.0268 U	0.0134 U	67 U	0.104	0.0268 U	1.68 U	0.067 U	3.99	0.067 U	0.05 U	0.05 U	0.067 U	0.067 U
Phenanthrene	0.0588	0.0164	700	0.583	0.0395	1.68 U	0.067 U	3.73	0.067 U	0.34	0.05 U	0.137	0.77
Pyrene	0.0941	0.0314	143	1.36	0.0997	1.68 U	0.067 U	3.97	0.067 U	1.04	0.05 U	0.278	2.74
Total PAHs	0.6219	0.237	1475.8	6.5738	0.9636	1.88	0.067 U	26.226	0.067 U	6.565	0.05 U	1.602	13.334

Please refer to notes at end of table.

Table A-1 - Analytical Results for Soil Samples (Metals and PAHs)

Area	B	B	B	B	B	C	C	C
Sample ID	5106-001024-021	5106-001024-017	5106-001024-001	5106-001024-002	5106-001024-013	B2 (9-11)	B3 (11-12)	4876-000302-026
Station	B-89	B-90	B-91	B-91	B-92	B-2	B-3	B-32
Sampling Date	10/24/2000	10/24/2000	10/24/2000	10/24/2000	10/24/2000	3/26/98	3/25/94	3/02/2000
Depth in Feet	2.5	10	2.5	7	10	9-11	11-12	1
Metals in mg/kg								
Antimony						0.5 UJ	0.5 UJ	2.5 UJ
Arsenic						2.72 J	11.8 J	2.9
Beryllium						0.5 U	0.782	0.18
Cadmium						0.666	1.3	0.2 U
Chromium						18.1	25.7	11
Copper						12.4	19	14.4
Lead						10 U	15.5	2.5 U
Mercury						0.05 U	0.05 U	0.1 U
Nickel						18.9	17.8	14.1
Selenium						0.5 U	0.5 U	1 U
Silver						1 U	1 U	0.3 U
Thallium						0.5 U	0.5 U	0.5 U
Zinc						49.8	76.9	38
TCLP-Lead								
PAHs in mg/kg								
Benzo(a)anthracene	0.0754	0.148	0.0134 U	0.409	1.32			
Benzo(a)pyrene	0.062	0.17	0.0134 U	0.361	2.35			
Benzo(b)fluoranthene	0.0468	0.1	0.0134 U	0.232	1.54			
Benzo(k)fluoranthene	0.048	0.0996	0.0134 U	0.261	1.09			
Chrysene	0.0681	0.168	0.0134 U	0.375	1.62			
Dibenz(ah)anthracene	0.0134 U	0.067 U	0.0134 U	0.067 U	0.253			
Indeno(1,2,3-cd)pyrene	0.0281	0.0912	0.0134 U	0.165	1.56			
Acenaphthene	0.0134 U	0.067 U	0.0134 U	0.0681	0.249			
Acenaphthylene	0.0134 U	0.067 U	0.0134 U	0.067 U	0.158			
Anthracene	0.0174	0.067 U	0.0134 U	0.113	0.331			
Benzo(ghi)perylene	0.0314	0.123	0.0134 U	0.186	2.49			
Fluoranthene	0.132	0.19	0.0134 U	0.584	4.22			
Fluorene	0.0134 U	0.067 U	0.0134 U	0.067 U	0.134			
Naphthalene	0.0134 U	0.067 U	0.0134 U	0.11	0.246			
Phenanthrene	0.0523	0.166	0.0134 U	0.351	1.84			
Pyrene	0.136	0.357	0.0134 U	0.694	6.69			
Total PAHs	0.6975	1.6128	0.0134 U	3.9091	26.091			

Notes:

1. U = Not detected at or above the method reporting limits.
2. J = Estimated Concentration.
3. R = Rejected Data (see Appendix F).
4. Shading Indicates Rejected Data.

Table A-2 - Analytical Results for Soil Samples (Diesel and Oil)

Area	Sample Number	Station	Sample Date	Depth in feet	NW Method TPH-D in mg/kg Diesel	Oil
A	5106-001027-069	B-100	10/27/00	5	27 U	67.6 U
A	5106-001027-070	B-100	10/27/00	10	26.7 U	66.7 U
A	5106-001027-071	B-100	10/27/00	20	29.9 U	74.6 U
A	5106-001027-072	B-100	10/27/00	26	29 U	72.5 U
A	5106-001026-063	B-101	10/26/00	5	26.3 U	65.8 U
A	5106-001026-064	B-101	10/26/00	10	27.8 U	69.4 U
A	5106-001026-065	B-101	10/26/00	20	28.2 U	70.4 U
A	5106-001026-066	B-101	10/26/00	26	27 U	67.6 U
A	5106-001026-059	B-102	10/26/00	5	26.7 U	66.7 U
A	5106-001026-060	B-102	10/26/00	10	1170	1760
A	5106-001026-061	B-102	10/26/00	20	28.2 U	70.4 U
A	5106-001027-073	B-103	10/27/00	5	26.3 U	65.8 U
A	5106-001027-074	B-103	10/27/00	10	27 U	67.6 U
A	5106-001027-075	B-103	10/27/00	20	28.6 U	71.4 U
A	5106-001027-076	B-103	10/27/00	26	28.6 U	71.4 U
A	4876-000302-024	B-20	3/2/00	1	36	50 U
A	4876-000301-020	B-38	3/1/00	10	34000 R	2500 UR
A	4876-000301-021	B-38	3/1/00	20	500 R	50 UR
A	4876-000301-023	B-38	3/1/00	26	170 R	50 UR
A	4876-000313-031	B-39	3/13/00	10	25000 R	5000 UR
A	4876-000313-036	B-39	3/13/00	28	25 UR	50 UR
A	4876-000313-037	B-40	3/13/00	5	910	50 U
A	4876-000313-038	B-40	3/13/00	10	25 U	50 U
A	4876-000313-043	B-41	3/13/00	5	500	50 U
A	4876-000313-044	B-41	3/13/00	10	25 U	50 U
A	4876-000313-049	B-43	3/13/00	10	25 U	50 U
A	4876-000313-051	B-43	3/13/00	20	25 UR	140 R
A	4876-000313-053	B-43	3/13/00	27	25 U	50 U
A	4876-000313-056	B-44	3/13/00	10	225 UR	290 R
A	4876-000313-058	B-44	3/13/00	20	25 U	50 U
A	4876-000313-060	B-44	3/13/00	26	25 U	50 U
A	4876-000316-062	B-45	3/16/00	10	25 U	50 U
A	4876-000316-063	B-45	3/16/00	18	360	50 U
A	4876-000316-064	B-45	3/16/00	22	25 U	50 U
A	4876-000316-067	B-46	3/16/00	12.5	25 U	50 U
A	4876-000316-068	B-46	3/16/00	19	25 U	50 U
A	4876-000316-069	B-46	3/16/00	25	25 U	50 U
A	4876-000316-071	B-47	3/16/00	2.5	450	50 U
A	4876-000316-073	B-47	3/16/00	10	25 U	62
A	4876-000316-075	B-47	3/16/00	20	25 U	58
A	4876-000316-076	B-47	3/16/00	25	25 U	50 U
A	4876-000316-078	B-48	3/16/00	6	25 U	160
A	4876-000316-079	B-48	3/16/00	11	25 U	1600
A	4876-000316-080	B-48	3/16/00	15	25 U	77
A	4876-000316-082	B-49	3/16/00	5	25 UR	50 UR

Please refer to notes at end of table.

Table A-2 - Analytical Results for Soil Samples (Diesel and Oil)

Area	Sample Number	Station	Sample Date	Depth in feet	NW Method TPH-D in mg/kg Diesel	Oil
A	4876-000316-084	B-49	3/16/00	13	25 UR	50 UR
A	5106-000921-045	B-53	9/21/00	4	25 U	50 U
A	5106-000921-046	B-54	9/21/00	1	25 U	50 U
A	5106-000921-043	B-55	9/21/00	1	25 U	50 U
A	5106-000921-048	B-56	9/21/00	1	45.2	72.1
A	5106-000921-047	B-57	9/21/00	1	41.6	191
A	5106-000921-049	B-68	9/21/00	2.5	653	1130
A	5106-000921-050	B-68	9/21/00	10	25.5	84.3
A	5106-000921-051	B-68	9/21/00	13	199	386
A	B-68-Duplicate	B-68	9/21/00	10	32.4	84.9
A	5106-000921-052	B-69	9/21/00	2.5	25 U	50 U
A	5106-000921-053	B-69	9/21/00	10	25 U	50 U
A	5106-000921-055	B-69	9/21/00	20	25 U	50 U
A	5106-000921-056	B-70	9/21/00	2.5	25 U	50 U
A	5106-000921-057	B-70	9/21/00	10	25 U	50 U
A	5106-000921-058	B-70	9/21/00	20	25 U	50 U
A	5106-000921-059	B-70	9/21/00	26.5	612	523
A	5106-000921-060	B-71	9/21/00	2.5	25 U	50 U
A	5106-000921-061	B-71	9/21/00	10	25 U	50 U
A	5106-000921-062	B-71	9/21/00	20	25 U	50 U
A	5106-000921-063	B-72	9/21/00	2.5	25 U	84
A	5106-000921-064	B-72	9/21/00	12.5	25 U	126
A	5106-000921-065	B-72	9/21/00	20	25 U	50 U
A	5106-000921-066	B-73	9/21/00	2.5	25 U	50 U
A	5106-000921-067	B-73	9/21/00	12.5	25 U	50 U
A	5106-000921-068	B-73	9/21/00	18	25 U	50 U
A	5106-000925-079	B-74	9/25/00	2.5	25 U	50 U
A	5106-000925-080	B-74	9/25/00	12.5	25 U	50 U
A	5106-000925-081	B-74	9/25/00	18	25 U	50 U
A	5106-000925-082	B-78	9/25/00	20	25 U	50 U
A	5106-000921-075	B-81	9/22/00	2.5	25 U	50 U
A	5106-000921-076	B-81	9/22/00	10	68.2	90.5
A	5106-000921-077	B-81	9/22/00	20	864	2020
A	5106-000921-070	B-82	9/22/00	2.5	250 U	673
A	5106-000921-071	B-82	9/22/00	10	250 U	1570
A	5106-000921-072	B-82	9/22/00	20	787	846
A	5106-000921-074	B-82	9/22/00	26	25 U	50 U
A	5106-000920-038	B-84	9/20/00	67.5	107	191
A	5106-000921-078	B-86	9/22/00	10	25 U	50 U
A	5106-001030-081	B-94	10/30/00	2.5	506 U	1300
A	5106-001030-082	B-94	10/30/00	10	24.4 U	61 U
A	5106-001030-083	B-94	10/30/00	20	28.6 U	71.4 U
A	5106-001030-084	B-94	10/30/00	25.5	28.6 U	71.4 U
A	5106-001106-095	B-97	11/6/00	3	24.7 U	61.7 U
A	5106-001106-096	B-97	11/6/00	5	26 U	64.9 U

Please refer to notes at end of table.

Table A-2 - Analytical Results for Soil Samples (Diesel and Oil)

Area	Sample Number	Station	Sample Date	Depth in feet	NW Method TPH-D in mg/kg Diesel	Oil
A	5106-001106-097	B-97	11/6/00	10	26.7 U	66.7 U
A	5106-001106-098	B-97	11/6/00	20	197	266
A	5106-001106-099	B-97	11/6/00	26	28.6 U	71.4 U
A	5106-001106-090	B-99	11/6/00	3	24.4 U	61 U
A	5106-001106-092	B-99	11/6/00	10	27.4 U	68.5 U
A	5106-001106-093	B-99	11/6/00	20	28.2 U	70.4 U
A	5106-001106-094	B-99	11/6/00	26	24.4 U	61 U
B	5106-001024-008	B-106	10/24/00	7	25 U	174
B	5106-001024-009	B-106	10/24/00	16.5	25 UR	50 UR
B	5106-001024-011	B-106	10/24/00	24	25 U	50 U
B	4876-000229-003	B-15	2/29/00	2	25 UR	50 UR
B	4876-000302-028	B-16	3/2/00	1.5	25 UR	50 UR
B	4876-000301-014	B-21	3/1/00	1.5	25 UR	50 UR
B	4876-000301-011	B-22	3/1/00	1.5	25 R	50 R
B	4876-000229-008	B-29	2/29/00	4	25 UR	50 UR
B	4876-000301-013	B-33	3/1/00	1.5	25 UR	50 UR
B	4876-000301-012	B-34	3/1/00	1.5	25 UR	50 UR
B	4876-000301-016	B-37	3/1/00	10.5	36 UR	300 R
B	T-1 B-4 0-2	B-4	3/26/98	0-2	25 U	50 U
B	T-1 B-5 0-2	B-5	3/26/98	0-2	500 U	6030
B	5106-000919-019	B-58	9/19/00	8	25 U	50 U
B	5106-000919-020	B-59	9/19/00	4	25 U	112
B	T-1 B-6 (0-2)	B-6	3/26/98	0-2	25 U	50 U
B	5106-000919-017	B-60	9/19/00	4	25 U	50 U
B	5106-000919-016	B-61	9/19/00	4	25 U	50 U
B	5106-000919-021	B-62	9/19/00	4	25 U	50 U
B	B-63-Duplicate	B-63	9/20/00	10.5	1170	3210
B	5106-000920-022	B-63/63a	9/20/00	6	500 U	1190
B	5106-000920-023	B-63/63a	9/20/00	10.5	3440	10000
B	5106-000920-024	B-63/63a	9/20/00	16	250 U	2180
B	5106-001024-054	B-63/63a	10/25/00	19	98.3	286
B	5106-001024-055	B-63/63a	10/25/00	24	25 U	50 U
B	5106-000919-005	B-64/64a	9/19/00	10.5	25 U	50 U
B	5106-001024-037	B-64/64a	10/25/00	2.5	25 U	50 U
B	5106-001024-040	B-64/64a	10/25/00	16.5	109	251
B	5106-001024-041	B-64/64a	10/25/00	19	39	105
B	5106-000919-006	B-65/65a	9/19/00	10.5	250 U	769
B	5106-000925-083	B-65/65a	9/25/00	16.5	500 U	9070
B	5106-000925-084	B-65/65a	9/25/00	19	25 U	50 U
B	5106-001024-043	B-65/65a	10/25/00	2.5	250 U	1170
B	5106-001024-046	B-65/65a	10/25/00	12	2500 U	20700
B	5106-000919-007	B-66/66a	9/19/00	10.5	1090	2380
B	5106-000919-008	B-66/66a	9/19/00	16	3830	6320
B	5106-000919-009	B-66/66a	9/19/00	19	87	217
B	5106-001024-047	B-66/66a	10/25/00	2.5	250 U	1650

Please refer to notes at end of table.

Table A-2 - Analytical Results for Soil Samples (Diesel and Oil)

Area	Sample Number	Station	Sample Date	Depth in feet	NW Method TPH-D in mg/kg Diesel	Oil
B	5106-000919-015	B-67/67a	9/19/00	13.5	29	62.7
B	5106-001030-085	B-67/67a	10/30/00	5.5	20.8 U	52.1 U
B	5106-001030-086	B-67/67a	10/30/00	13.5	28.6 U	124
B	5106-001030-087	B-67/67a	10/30/00	19.5	24.1 U	60.2 U
B	5106-001030-089	B-67/67a	10/30/00	23.5	46.4	203
B	5106-000919-010	B-83	9/19/00	4	25 U	50 U
B	5106-000919-014	B-83	9/19/00	12	25 U	50 U
B	5106-000920-025	B-85	9/20/00	12.5	1060	3000
B	5106-000920-026	B-85	9/20/00	19	1310	2640
B	5106-000920-028	B-85	9/20/00	24	25 U	50 U
B	5106-001024-032	B-87	10/25/00	2.5	25 U	1860
B	5106-001024-034	B-87	10/25/00	10.5	25 U	50 U
B	5106-001024-035	B-87	10/25/00	19	25 U	98.7
B	5106-001024-036	B-87	10/25/00	24	25 U	144
B	5106-001024-027	B-88	10/25/00	6.5	25 U	148
B	5106-001024-029	B-88	10/25/00	16.5	49	164
B	5106-001024-030	B-88	10/25/00	19	25 U	50 U
B	5106-001024-031	B-88	10/25/00	24	46	50 U
B	5106-001024-021	B-89	10/24/00	2.5	25 U	50 U
B	5106-001024-023	B-89	10/24/00	16.5	25 U	50 U
B	5106-001024-024	B-89	10/24/00	19	45.7	82.5
B	5106-001024-025	B-89	10/24/00	24	25 U	50 U
B	5106-001024-018	B-90	10/24/00	16.5	25 U	50 U
B	5106-001024-019	B-90	10/24/00	19	324	1150
B	5106-001024-020	B-90	10/24/00	24	35.9	61.8
B	B-90-Duplicate	B-90	10/24/00	16.5	25 U	50 U
B	5106-001024-001	B-91	10/24/00	2.5	25 U	50 U
B	5106-001024-005	B-91	10/24/00	16.5	250 U	1150
B	5106-001024-006	B-91	10/24/00	19	25 U	50 U
B	B-91-Duplicate	B-91	10/24/00	2.5	25 U	50 U
B	5106-001024-013	B-92	10/24/00	10	169	310
B	5106-001024-015	B-92	10/24/00	17.5	250 U	1970

Notes:

1. U = Not detected at or above the method reporting limits.
2. J = Estimated Concentration.
3. R = Rejected Data (see Appendix F).
4. Shading indicates Rejected Data.

Table A-3 - Analytical Results for Water Samples

Sample ID	5106-011001-108	5106-011001-109	5106-011001-107	5106-010928-103	5106-010928-104
Station	MW-1	MW-1 (Dup)	MW-2	MW-3	MW-4
Sampling Date	10/01/2001	10/01/2001	10/01/2001	9/28/2001	9/28/2001
Depth in Feet	17 - 32	17 - 32	17 - 32	17 - 32	17 - 32
Total Suspended Solids	36	35	55	720	130
Total Metals in µg/L					
Arsenic	2.01	1.06	12.8	14	6.45
Cadmium	1 U	1 U			1 U
Chromium	3.25	2.65			5.12
Copper	4.74	3.88	2 U	40.2	4.48
Lead	1.16	1 U	1 U	36.2	2.49
Mercury	0.2 U	0.2 U			0.2 U
Nickel	5.25	4.49			3.86
Silver	1 U	1 U			1 U
Zinc	10.6	8.43			9.08
Dissolved Metals in µg/L					
Arsenic	1 U	1 U	14.5	11	6.51
Copper	2.29	2.03	2 U	2 U	2 U
Lead	1.37	1 U	1 U	1 U	1 U
PAHs in µg/L					
Benzo(a)anthracene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(a)pyrene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(b)fluoranthene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(k)fluoranthene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Chrysene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Dibenz(ah)anthracene	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Indeno(1,2,3-cd)pyrene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Acenaphthene	0.1 U	0.1 U	0.121	0.192	0.72
Acenaphthylene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Anthracene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Benzo(ghi)perylene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Fluoranthene	0.1 U	0.1 U	0.119	0.1 U	0.1 U
Fluorene	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Naphthalene	0.1 U	0.1 U	0.1 U	0.1 U	0.291
Phenanthrene	0.1 U	0.1 U	1.25	0.138	0.576
Pyrene	0.1 U	0.1 U	0.564	0.1 U	0.123
Total PAHs	0.2 U	0.2 U	2.054	0.33	1.71
TPH in µg/L					
Diesel	416.2	338.2			250 U
Oil	500 U	500 U			500 U
Volatiles in µg/L					
Tetrachloroethene	2.76	3.29			1.0 U

Table A-3 - Analytical Results for Water Samples

Sample ID	5106-010928-102	5106-010928-105	5106-011001-106
Station	MW-5	MW-6	MW-7
Sampling Date	9/28/2001	9/28/2001	10/01/2001
Depth in Feet	19 - 34	17 - 32	17 - 32
Total Suspended Solids	108	50	20 U
Total Metals in µg/L			
Arsenic	12.1	2.72	1.38
Cadmium			
Chromium			
Copper	2.95	2.51	2 U
Lead	1.46	1 U	4.47
Mercury			
Nickel			
Silver			
Zinc			11.6
Dissolved Metals in µg/L			
Arsenic	11.3	3.65	1 U
Copper	2 U	2 U	2 U
Lead	1 U	1 U	1 U
PAHs in µg/L			
Benzo(a)anthracene	0.1 U	0.1 U	0.1 U
Benzo(a)pyrene	0.1 U	0.1 U	0.1 U
Benzo(b)fluoranthene	0.1 U	0.1 U	0.1 U
Benzo(k)fluoranthene	0.1 U	0.1 U	0.1 U
Chrysene	0.1 U	0.1 U	0.1 U
Dibenz(ah)anthracene	0.2 U	0.2 U	0.2 U
Indeno(1,2,3-cd)pyrene	0.1 U	0.1 U	0.1 U
Acenaphthene	0.448	0.1 U	0.1 U
Acenaphthylene	0.1 U	0.1 U	0.1 U
Anthracene	0.1 U	0.1 U	0.1 U
Benzo(ghi)perylene	0.1 U	0.1 U	0.1 U
Fluoranthene	0.1 U	0.1 U	0.1 U
Fluorene	0.1 U	0.1 U	0.1 U
Naphthalene	0.1 U	0.1 U	0.1 U
Phenanthrene	1.16	0.1 U	0.153
Pyrene	0.172	0.1 U	0.153
Total PAHs	1.78	0.2 U	0.306
TPH in µg/L			
Diesel			
Oil			
Volatiles in µg/L			
Tetrachloroethene			

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Notes:

1. U = Not detected at or above the method reporting limits.
2. J = Estimated Concentration.
3. R = Rejected Data (see Appendix F).

Appendix B

APPENDIX B
HUMAN HEALTH RISK ASSESSMENT TABLES

Table B-1 - Area A Risk Calculations
Soil Ingestion, Resident
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
	RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs										
Benzo(a)anthracene	2.0E+00	6.7E-01	5.1E-05	4.9E-07	--	--	5.3E-06	4.4E-08	3.9E-06	3.2E-08
Benzo(a)pyrene	1.8E+00	5.5E-01	4.6E-05	4.0E-07	--	--	4.8E-06	3.6E-08	3.5E-05	2.6E-07
Benzo(b)fluoranthene	1.4E+00	4.0E-01	3.6E-05	2.9E-07	--	--	3.7E-06	2.6E-08	2.7E-06	1.9E-08
Dibenz(a,h)anthracene	1.6E-01	9.0E-02	4.1E-06	6.6E-08	--	--	4.3E-07	5.9E-09	3.1E-06	4.3E-08
Indeno(1,2,3-cd)pyrene	7.4E-01	2.8E-01	1.9E-05	2.0E-07	--	--	2.0E-06	1.8E-08	1.4E-06	1.3E-08
Metals										
Arsenic	8.4E+00	3.3E+00	2.1E-04	2.4E-06	7.2E-01	8.0E-03	2.2E-05	2.2E-07	3.4E-05	3.3E-07
			TOTAL HAZARD INDEX		7.E-01	8.E-03	TOTAL CANCER RISK		8.E-05	7.E-07

Notes:
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-1 - Area A Risk Calculations
Dermal Contact with Soil, Resident
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	ABS	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs											
Benzo(a)anthracene	0.13	2.0E+00	6.7E-01	8.3E-05	8.6E-07	--	--	7.8E-06	7.6E-08	5.7E-06	5.6E-08
Benzo(a)pyrene	0.13	1.8E+00	5.5E-01	7.5E-05	7.1E-07	--	--	7.0E-06	6.2E-08	5.1E-05	4.6E-07
Benzo(b)fluoranthene	0.13	1.4E+00	4.0E-01	5.8E-05	5.1E-07	--	--	5.5E-06	4.5E-08	4.0E-06	3.3E-08
Dibenz(a,h)anthracene	0.13	1.6E-01	9.0E-02	6.6E-06	1.2E-07	--	--	6.2E-07	1.0E-08	4.6E-06	7.5E-08
Indeno(1,2,3-cd)pyrene	0.13	7.4E-01	2.8E-01	3.1E-05	3.6E-07	--	--	2.9E-06	3.2E-08	2.1E-06	2.3E-08
Metals											
Arsenic	0.03	8.4E+00	3.3E+00	8.1E-05	9.8E-07	2.7E-01	3.3E-03	7.6E-06	8.6E-08	1.1E-05	1.3E-07
				TOTAL HAZARD INDEX		3.E-01	3.E-03	TOTAL CANCER RISK		8.E-05	8.E-07

Notes:
ABS = Dermal Absorption Factor (EPA, 1998).
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-1 - Area A Risk Calculations
Vapor Inhalation (Indoor Air), Resident
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	Indoor Air EPC in mg/m³		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
	RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
Volatile Organic Compounds										
Tetrachloroethene	1.2E-05	1.2E-05	6.4E-06	6.4E-06	7.6E-05	7.6E-05	1.4E-06	6.5E-07	3.6E-09	1.7E-09
			TOTAL HAZARD INDEX		**8.E-05**	**8.E-05**	**TOTAL CANCER RISK**		**4.E-09**	**2.E-09**

Notes:
Indoor Air EPC modeled from maximum detected groundwater concentration using DEQ's RBDM Guidance (DEQ, 2001b).
Outdoor Air not evaluated since indoor air risks and hazards were acceptable.
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-1 - Area A Risk Calculations
Fugitive Dust Inhalation (Outdoor Air), Resident
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	PEF in m^3/kg	Outdoor Air EPC in mg/m^3		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs											
Benzo(a)anthracene	1.32E+09	1.5E-09	5.1E-10	8.0E-10	2.7E-10	--	--	1.8E-10	2.8E-11	5.5E-11	8.6E-12
Benzo(a)pyrene	1.32E+09	1.4E-09	4.2E-10	7.2E-10	2.2E-10	--	--	1.6E-10	2.3E-11	4.9E-10	7.0E-11
Benzo(b)fluoranthene	1.32E+09	1.1E-09	3.0E-10	5.6E-10	1.6E-10	--	--	1.2E-10	1.6E-11	3.8E-11	5.1E-12
Dibenz(a,h)anthracene	1.32E+09	1.2E-10	6.8E-11	6.4E-11	3.6E-11	--	--	1.4E-11	3.7E-12	4.4E-11	1.1E-11
Indeno(1,2,3-cd)pyrene	1.32E+09	5.6E-10	2.1E-10	3.0E-10	1.1E-10	--	--	6.6E-11	1.2E-11	2.0E-11	3.6E-12
Metals											
Arsenic	1.32E+09	6.4E-09	2.5E-09	3.4E-09	1.3E-09	--	--	7.4E-10	1.4E-10	1.1E-08	2.0E-09
				TOTAL HAZARD INDEX		0.E+00	0.E+00	TOTAL CANCER RISK		1.E-08	2.E-09

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Notes:
Outdoor Air EPC = Soil EPC (See Table 4)/PEF.
PEF = Particulate Emission Factor.
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-2 - Area A Risk Calculations
Soil Ingestion, Commercial Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
	RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs										
Benzo(a)anthracene	2.0E+00	6.7E-01	2.0E-06	3.3E-07	--	--	7.0E-07	2.8E-08	5.1E-07	2.1E-08
Benzo(a)pyrene	1.8E+00	5.5E-01	1.8E-06	2.7E-07	--	--	6.3E-07	2.3E-08	4.6E-06	1.7E-07
Benzo(b)fluoranthene	1.4E+00	4.0E-01	1.4E-06	2.0E-07	--	--	4.9E-07	1.7E-08	3.6E-07	1.2E-08
Dibenz(a,h)anthracene	1.6E-01	9.0E-02	1.6E-07	4.4E-08	--	--	5.6E-08	3.8E-09	4.1E-07	2.8E-08
Indeno(1,2,3-cd)pyrene	7.4E-01	2.8E-01	7.2E-07	1.4E-07	--	--	2.6E-07	1.2E-08	1.9E-07	8.6E-09
Metals										
Arsenic	8.4E+00	3.3E+00	8.2E-06	1.6E-06	2.7E-02	5.4E-03	2.9E-06	1.4E-07	4.4E-06	2.1E-07
			TOTAL HAZARD INDEX		3.E-02	5.E-03	TOTAL CANCER RISK		1.E-05	4.E-07

Notes:
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-2 - Area A Risk Calculations
Dermal Contact with Soil, Commercial Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	ABS	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs											
Benzo(a)anthracene	0.13	2.0E+00	6.7E-01	8.3E-07	2.2E-07	–	–	3.0E-07	1.9E-08	2.2E-07	1.4E-08
Benzo(a)pyrene	0.13	1.8E+00	5.5E-01	7.5E-07	1.8E-07	–	–	2.7E-07	1.5E-08	2.0E-06	1.1E-07
Benzo(b)fluoranthene	0.13	1.4E+00	4.0E-01	5.8E-07	1.3E-07	–	–	2.1E-07	1.1E-08	1.5E-07	8.2E-09
Dibenz(a,h)anthracene	0.13	1.6E-01	9.0E-02	6.7E-08	2.9E-08	–	–	2.4E-08	2.5E-09	1.7E-07	1.8E-08
Indeno(1,2,3-cd)pyrene	0.13	7.4E-01	2.8E-01	3.1E-07	9.1E-08	–	–	1.1E-07	7.8E-09	8.0E-08	5.7E-09
Metals											
Arsenic	0.03	8.4E+00	3.3E+00	8.1E-07	2.5E-07	2.7E-03	8.3E-04	2.9E-07	2.1E-08	4.3E-07	3.2E-08
				TOTAL HAZARD INDEX		3.E-03	8.E-04	TOTAL CANCER RISK		3.E-06	2.E-07

Notes:
ABS = Dermal Absorption Factor (EPA, 1998).
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-2 - Area A Risk Calculations
Vapor Inhalation (Indoor Air), Commercial Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	Indoor Air EPC in mg/m³		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		CSF in (mg/kg-day)-1	Cancer Risk	
	RME	CT	RME	CT	RME	CT	RME	CT		RME	CT
Volatile Organic Compounds											
Tetrachloroethene	4.0E-06	4.0E-06	5.9E-07	5.9E-07	5.4E-06	5.4E-06	2.1E-07	5.1E-08	2.6E-03	5.5E-10	1.3E-10
			TOTAL HAZARD INDEX		5.E-06	5.E-06	TOTAL CANCER RISK			6.E-10	1.E-10

Notes:
Indoor Air EPC modeled from maximum detected groundwater concentration using DEQ's RBDM Guidance (DEQ, 2001b).
Outdoor Air not evaluated since indoor air risks and hazards were acceptable.
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-2 - Area A Risk Calculations
Fugitive Dust Inhalation (Outdoor Air), Commercial Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	PEF in m^3/kg	Outdoor Air EPC in mg/m^3		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs											
Benzo(a)anthracene	1.32E+09	1.5E-09	5.1E-10	2.3E-10	7.5E-11	--	--	8.0E-11	6.5E-12	2.5E-11	2.0E-12
Benzo(a)pyrene	1.32E+09	1.4E-09	4.2E-10	2.0E-10	6.2E-11	--	--	7.2E-11	5.3E-12	2.2E-10	1.6E-11
Benzo(b)fluoranthene	1.32E+09	1.1E-09	3.0E-10	1.6E-10	4.5E-11	--	--	5.6E-11	3.9E-12	1.7E-11	1.2E-12
Dibenz(a,h)anthracene	1.32E+09	1.2E-10	6.8E-11	1.8E-11	1.0E-11	--	--	6.4E-12	8.7E-13	2.0E-11	2.7E-12
Indeno(1,2,3-cd)pyrene	1.32E+09	5.6E-10	2.1E-10	8.3E-11	3.2E-11	--	--	3.0E-11	2.7E-12	9.2E-12	8.4E-13
Metals											
Arsenic	1.32E+09	6.4E-09	2.5E-09	9.5E-10	3.7E-10	--	--	3.4E-10	3.2E-11	5.1E-09	4.8E-10
				TOTAL HAZARD INDEX		0.E+00	0.E+00	TOTAL CANCER RISK		5.E-09	5.E-10

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Notes:
Outdoor Air EPC = Soil EPC (See Table 4)/PEF.
PEF = Particulate Emission Factor.
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-3 - Area A Risk Calculations
Soil Ingestion, Excavation Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
	RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs										
Benzo(a)anthracene	3.7E-01	3.7E-01	6.3E-08	1.3E-08	--	--	8.9E-10	9.3E-11	6.5E-10	6.8E-11
Benzo(a)pyrene	3.7E-01	3.3E-01	6.3E-08	1.2E-08	--	--	8.9E-10	8.3E-11	6.5E-09	6.1E-10
Benzo(b)fluoranthene	3.4E-01	2.7E-01	5.7E-08	9.5E-09	--	--	8.2E-10	6.8E-11	6.0E-10	5.0E-11
Dibenz(a,h)anthracene	7.0E-02	6.0E-02	1.2E-08	2.1E-09	--	--	1.7E-10	1.5E-11	1.2E-09	1.1E-10
Indeno(1,2,3-cd)pyrene	2.0E-01	1.8E-01	3.4E-08	6.3E-09	--	--	4.8E-10	4.5E-11	3.5E-10	3.3E-11
Metals										
Arsenic	6.0E+00	3.4E+00	1.0E-06	1.2E-07	3.4E-03	4.0E-04	1.4E-08	8.6E-10	2.2E-08	1.3E-09
			TOTAL HAZARD INDEX		**3.E-03**	**4.E-04**	**TOTAL CANCER RISK**		**3.E-08**	**2.E-09**

Notes:
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-3 - Area A Risk Calculations
Dermal Contact with Soil, Excavation Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	ABS	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs											
Benzo(a)anthracene	0.13	3.7E-01	3.7E-01	6.9E-08	1.6E-08	–	–	9.9E-10	1.2E-10	7.2E-10	8.5E-11
Benzo(a)pyrene	0.13	3.7E-01	3.3E-01	6.9E-08	1.5E-08	–	–	9.9E-10	1.0E-10	7.2E-09	7.6E-10
Benzo(b)fluoranthene	0.13	3.4E-01	2.7E-01	6.4E-08	1.2E-08	–	–	9.1E-10	8.5E-11	6.7E-10	6.2E-11
Dibenz(a,h)anthracene	0.13	7.0E-02	6.0E-02	1.3E-08	2.6E-09	–	–	1.9E-10	1.9E-11	1.4E-09	1.4E-10
Indeno(1,2,3-cd)pyrene	0.13	2.0E-01	1.8E-01	3.8E-08	7.9E-09	–	–	5.4E-10	5.7E-11	3.9E-10	4.1E-11
Metals											
Arsenic	0.03	6.0E+00	3.4E+00	2.6E-07	3.4E-08	8.7E-04	1.1E-04	3.7E-09	2.5E-10	5.6E-09	3.7E-10
				TOTAL HAZARD INDEX		**9.E-04**	**1.E-04**	**TOTAL CANCER RISK**		**2.E-08**	**1.E-09**

Notes:
ABS = Dermal Absorption Factor (EPA, 1998).
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-3 - Area A Risk Calculations
Vapor Inhalation (Outdoor Air), Excavation Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	Indoor Air EPC in mg/m³		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
	RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
Volatile Organic Compounds										
Tetrachloroethene	6.2E-07	6.2E-07	3.3E-09	3.3E-09	3.0E-08	3.0E-08	4.7E-11	2.4E-11	9.5E-14	4.7E-14
			TOTAL HAZARD INDEX		3.E-08	3.E-08	TOTAL CANCER RISK		9.E-14	5.E-14

Notes:
Indoor Air EPC modeled from maximum detected groundwater concentration using DEQ's RBDM Guidance (DEQ, 2001b).
Outdoor Air not evaluated since indoor air risks and hazards were acceptable.
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-3 - Area A Risk Calculations
Fugitive Dust Inhalation (Outdoor Air), Excavation Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	PEF in m^3/kg	Outdoor Air EPC in mg/m^3		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs											
Benzo(a)anthracene	1.32E+09	2.8E-10	2.8E-10	1.5E-12	1.5E-12	--	--	2.1E-14	1.1E-14	6.6E-15	3.3E-15
Benzo(a)pyrene	1.32E+09	2.8E-10	2.5E-10	1.5E-12	1.3E-12	--	--	2.1E-14	9.6E-15	6.6E-14	3.0E-14
Benzo(b)fluoranthene	1.32E+09	2.6E-10	2.0E-10	1.4E-12	1.1E-12	--	--	2.0E-14	7.8E-15	6.1E-15	2.4E-15
Dibenz(a,h)anthracene	1.32E+09	5.8E-11	4.5E-11	2.8E-13	2.4E-13	--	--	4.1E-15	1.7E-15	1.3E-14	5.4E-15
Indeno(1,2,3-cd)pyrene	1.32E+09	1.5E-10	1.4E-10	8.1E-13	7.3E-13	--	--	1.2E-14	5.2E-15	3.6E-15	1.6E-15
Metals											
Arsenic	1.32E+09	4.5E-09	2.6E-09	2.4E-11	1.4E-11	--	--	3.5E-13	9.9E-14	5.2E-12	1.5E-12
				TOTAL HAZARD INDEX		0.E+00	0.E+00	TOTAL CANCER RISK		5.E-12	2.E-12

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Notes:
Outdoor Air EPC = Soil EPC (See Table 4)/PEF.
PEF = Particulate Emission Factor.
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-4 - Area B Risk Calculations
Soil Ingestion, Resident
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
	RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs										
Benzo(a)anthracene	1.5E-01	6.0E-02	3.8E-06	4.4E-08	--	--	4.0E-07	4.0E-09	2.9E-07	2.9E-09
Benzo(a)pyrene	1.9E-01	7.0E-02	4.9E-06	5.1E-08	--	--	5.1E-07	4.6E-09	3.7E-06	3.4E-08
Benzo(b)fluoranthene	1.3E-01	6.0E-02	3.3E-06	4.4E-08	--	--	3.5E-07	4.0E-09	2.5E-07	2.9E-09
Indeno(1,2,3-cd)pyrene	1.2E-01	5.0E-02	3.1E-06	3.7E-08	--	--	3.2E-07	3.3E-09	2.3E-07	2.4E-09
Metals										
Arsenic	3.1E+00	2.9E+00	7.9E-05	2.1E-06	2.6E-01	7.1E-03	8.3E-06	1.9E-07	1.2E-05	2.9E-07
			TOTAL HAZARD INDEX		**3.E-01**	**7.E-03**	**TOTAL CANCER RISK**		**2.E-05**	**3.E-07**

Notes:
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-4 - Area B Risk Calculations
Dermal Contact with Soil, Resident
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	ABS	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs											
Benzo(a)anthracene	0.13	1.5E-01	6.0E-02	6.2E-06	7.7E-08	--	--	5.8E-07	6.8E-09	4.3E-07	5.0E-09
Benzo(a)pyrene	0.13	1.9E-01	7.0E-02	7.9E-06	9.0E-08	--	--	7.4E-07	7.9E-09	5.4E-06	5.8E-08
Benzo(b)fluoranthene	0.13	1.3E-01	6.0E-02	5.4E-06	7.7E-08	--	--	5.1E-07	6.8E-09	3.7E-07	5.0E-09
Indeno(1,2,3-cd)pyrene	0.13	1.2E-01	5.0E-02	5.0E-06	6.4E-08	--	--	4.7E-07	5.7E-09	3.4E-07	4.1E-09
Metals											
Arsenic	0.03	3.1E+00	2.9E+00	3.0E-05	8.6E-07	9.9E-02	2.9E-03	2.8E-06	7.6E-08	4.2E-06	1.1E-07
				TOTAL HAZARD INDEX		1.E-01	3.E-03	TOTAL CANCER RISK		1.E-05	2.E-07

Notes:
ABS = Dermal Absorption Factor (EPA, 1998).
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-4 - Area B Risk Calculations
Fugitive Dust Inhalation (Outdoor Air), Resident
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	PEF in m^3/kg	Outdoor Air EPC in mg/m^3		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs											
Benzo(a)anthracene	1.32E+09	1.1E-10	4.5E-11	6.0E-11	2.4E-11	--	--	2.9E-11	2.5E-12	8.9E-12	7.7E-13
Benzo(a)pyrene	1.32E+09	1.4E-10	5.3E-11	7.6E-11	2.8E-11	--	--	3.6E-11	2.9E-12	1.1E-10	8.9E-12
Benzo(b)fluoranthene	1.32E+09	9.8E-11	4.5E-11	5.2E-11	2.4E-11	--	--	2.5E-11	2.5E-12	7.7E-12	7.7E-13
Indeno(1,2,3-cd)pyrene	1.32E+09	9.1E-11	3.8E-11	4.8E-11	2.0E-11	--	--	2.3E-11	2.1E-12	7.1E-12	6.4E-13
Metals											
Arsenic	1.32E+09	2.3E-09	2.2E-09	1.2E-09	1.2E-09	--	--	5.9E-10	1.2E-10	8.9E-09	1.8E-09
				TOTAL HAZARD INDEX		**0.E+00**	**0.E+00**	**TOTAL CANCER RISK**		**9.E-09**	**2.E-09**

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Notes:
Outdoor Air EPC = Soil EPC (See Table 4)/PEF.
PEF = Particulate Emission Factor.
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-5 - Area B Risk Calculations
Soil Ingestion, Commercial Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
	RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs										
Benzo(a)anthracene	1.5E-01	6.0E-02	1.5E-07	2.9E-08	--	--	5.2E-08	2.5E-09	3.8E-08	1.8E-09
Benzo(a)pyrene	1.9E-01	7.0E-02	1.9E-07	3.4E-08	--	--	6.6E-08	2.9E-09	4.8E-07	2.1E-08
Benzo(b)fluoranthene	1.3E-01	6.0E-02	1.3E-07	2.9E-08	--	--	4.5E-08	2.5E-09	3.3E-08	1.8E-09
Indeno(1,2,3-cd)pyrene	1.2E-01	5.0E-02	1.2E-07	2.4E-08	--	--	4.2E-08	2.1E-09	3.1E-08	1.5E-09
Metals										
Arsenic	3.1E+00	2.9E+00	3.0E-06	1.4E-06	1.0E-02	4.7E-03	1.1E-06	1.2E-07	1.6E-06	1.8E-07
			TOTAL HAZARD INDEX		**1.E-02**	**5.E-03**	**TOTAL CANCER RISK**		**2.E-06**	**2.E-07**

Notes:
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-5 - Area B Risk Calculations
Dermal Contact with Soil, Commercial Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	ABS	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs											
Benzo(a)anthracene	0.13	1.5E-01	6.0E-02	6.3E-08	2.0E-08	--	--	2.2E-08	1.7E-09	1.6E-08	1.2E-09
Benzo(a)pyrene	0.13	1.9E-01	7.0E-02	7.9E-08	2.3E-08	--	--	2.8E-08	2.0E-09	2.1E-07	1.4E-08
Benzo(b)fluoranthene	0.13	1.3E-01	6.0E-02	5.4E-08	2.0E-08	--	--	1.9E-08	1.7E-09	1.4E-08	1.2E-09
Indeno(1,2,3-cd)pyrene	0.13	1.2E-01	5.0E-02	5.0E-08	1.6E-08	--	--	1.8E-08	1.4E-09	1.3E-08	1.0E-09
Metals											
Arsenic	0.03	3.1E+00	2.9E+00	3.0E-07	2.2E-07	9.9E-04	7.3E-04	1.1E-07	1.9E-08	1.6E-07	2.8E-08
				TOTAL HAZARD INDEX		1.E-03	7.E-04	TOTAL CANCER RISK		4.E-07	5.E-08

Notes:
ABS = Dermal Absorption Factor (EPA, 1998).
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-5 - Area B Risk Calculations
Fugitive Dust Inhalation (Outdoor Air), Commercial Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	PEF in m^3/kg	Outdoor Air EPC in mg/m^3		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs											
Benzo(a)anthracene	1.32E+09	1.1E-10	4.5E-11	1.7E-11	6.8E-12	--	--	6.0E-12	5.8E-13	1.9E-12	1.8E-13
Benzo(a)pyrene	1.32E+09	1.4E-10	5.3E-11	2.1E-11	7.9E-12	--	--	7.6E-12	6.8E-13	2.4E-11	2.1E-12
Benzo(b)fluoranthene	1.32E+09	9.8E-11	4.5E-11	1.5E-11	6.8E-12	--	--	5.2E-12	5.8E-13	1.6E-12	1.8E-13
Indeno(1,2,3-cd)pyrene	1.32E+09	9.1E-11	3.8E-11	1.4E-11	5.6E-12	--	--	4.8E-12	4.8E-13	1.5E-12	1.5E-13
Metals											
Arsenic	1.32E+09	2.8E-09	2.2E-09	3.5E-10	3.3E-10	--	--	1.2E-10	2.8E-11	1.9E-09	4.2E-10
				TOTAL HAZARD INDEX		0.E+00	0.E+00	**TOTAL CANCER RISK**		2.E-09	4.E-10

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Notes:
Outdoor Air EPC = Soil EPC (See Table 4)/PEF.
PEF = Particulate Emission Factor.
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-6 - Area B Risk Calculations
Soil Ingestion, Excavation Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
	RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs										
Benzo(a)anthracene	1.5E+00	4.0E-01	2.5E-07	1.4E-08	--	--	3.6E-09	1.0E-10	2.6E-09	7.3E-11
Benzo(a)pyrene	2.1E+00	4.7E-01	3.6E-07	1.7E-08	--	--	5.1E-09	1.2E-10	3.7E-08	8.6E-10
Benzo(b)fluoranthene	1.4E+00	3.7E-01	2.4E-07	1.3E-08	--	--	3.4E-09	9.3E-11	2.5E-09	6.8E-11
Dibenz(a,h)anthracene	2.3E-01	1.1E-01	3.9E-08	3.9E-09	--	--	5.6E-10	2.8E-11	4.1E-09	2.0E-10
Indeno(1,2,3-cd)pyrene	9.0E-01	2.9E-01	1.5E-07	1.0E-08	--	--	2.2E-09	7.3E-11	1.6E-09	5.3E-11
Metals										
Arsenic	3.3E+00	2.9E+00	5.6E-07	1.0E-07	1.9E-03	3.4E-04	8.0E-09	7.3E-10	1.2E-08	1.1E-09
			TOTAL HAZARD INDEX		2.E-03	3.E-04	TOTAL CANCER RISK		6.E-08	2.E-09

Notes:
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-6 - Area B Risk Calculations
Dermal Contact with Soil, Excavation Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	ABS	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs											
Benzo(a)anthracene	0.13	1.5E+00	4.0E-01	2.8E-07	1.8E-08	--	--	4.0E-09	1.3E-10	2.9E-09	9.2E-11
Benzo(a)pyrene	0.13	2.1E+00	4.7E-01	3.9E-07	2.1E-08	--	--	5.6E-09	1.5E-10	4.1E-08	1.1E-09
Benzo(b)fluoranthene	0.13	1.4E+00	3.7E-01	2.6E-07	1.6E-08	--	--	3.8E-09	1.2E-10	2.7E-09	8.5E-11
Dibenz(a,h)anthracene	0.13	2.3E-01	1.1E-01	4.3E-08	4.8E-09	--	--	6.2E-10	3.5E-11	4.5E-09	2.5E-10
Indeno(1,2,3-cd)pyrene	0.13	9.0E-01	2.9E-01	1.7E-07	1.3E-08	--	--	2.4E-09	9.1E-11	1.8E-09	6.6E-11
Metals											
Arsenic	0.03	3.3E+00	2.9E+00	1.4E-07	2.9E-08	4.8E-04	9.8E-05	2.0E-09	2.1E-10	3.1E-09	3.2E-10
				TOTAL HAZARD INDEX		5.E-04	1.E-04	TOTAL CANCER RISK		6.E-08	2.E-09

Notes:
ABS = Dermal Absorption Factor (EPA, 1998).
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

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Table B-6 - Area B Risk Calculations
Fugitive Dust Inhalation (Outdoor Air), Excavation Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	PEF in m^3/kg	Outdoor Air EPC in mg/m^3		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
PAHs											
Benzo(a)anthracene	1.3E+09	1.1E-09	3.0E-10	6.1E-12	1.6E-12	--	--	8.7E-14	1.2E-14	2.7E-14	3.6E-15
Benzo(a)pyrene	1.3E+09	1.6E-09	3.6E-10	8.5E-12	1.9E-12	--	--	1.2E-13	1.4E-14	3.8E-13	4.2E-14
Benzo(b)fluoranthene	1.3E+09	1.1E-09	2.8E-10	5.7E-12	1.5E-12	--	--	8.1E-14	1.1E-14	2.5E-14	3.3E-15
Dibenz(a,h)anthracene	1.3E+09	1.7E-10	8.3E-11	9.3E-13	4.5E-13	--	--	1.3E-14	3.2E-15	4.1E-14	9.9E-15
Indeno(1,2,3-cd)pyrene	1.3E+09	6.8E-10	2.2E-10	3.7E-12	1.2E-12	--	--	5.2E-14	8.4E-15	1.6E-14	2.6E-15
Metals											
Arsenic	1.3E+09	2.5E-09	2.2E-09	1.3E-11	1.2E-11	--	--	1.9E-13	8.4E-14	2.9E-12	1.3E-12
				TOTAL HAZARD INDEX		0.E+00	0.E+00	TOTAL CANCER RISK		3.E-12	1.E-12

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Notes:
Outdoor Air EPC = Soil EPC (See Table 4)/PEF.
PEF = Particulate Emission Factor.
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-7 - Area C Risk Calculations
Soil Ingestion, Resident
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
	RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
Metals										
Arsenic	2.9E+00	2.9E+00	7.4E-05	2.1E-06	2.5E-01	7.1E-03	7.7E-06	1.9E-07	1.2E-05	2.9E-07
			TOTAL HAZARD INDEX		**2.E-01**	**7.E-03**	**TOTAL CANCER RISK**		**1.E-05**	**3.E-07**

Notes:
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-7 - Area C Risk Calculations
Dermal Contact with Soil, Resident
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	ABS	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
Metals											
Arsenic	0.03	2.9E+00	2.9E+00	2.8E-05	8.6E-07	9.3E-02	2.9E-03	2.6E-06	7.6E-08	3.9E-06	1.1E-07
				TOTAL HAZARD INDEX		9.E-02	3.E-03	TOTAL CANCER RISK		4.E-06	1.E-07

Notes:
ABS = Dermal Absorption Factor (EPA, 1998).
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-7 - Area C Risk Calculations
Fugitive Dust Inhalation (Outdoor Air), Resident
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	PEF in m^3/kg	Outdoor Air EPC in mg/m^3		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
Metals											
Arsenic	1.32E+09	2.2E-09	2.2E-09	1.2E-09	1.2E-09	–	–	5.6E-10	1.2E-10	8.3E-09	1.8E-09
				TOTAL HAZARD INDEX		0.E+00	0.E+00	TOTAL CANCER RISK		8.E-09	2.E-09

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Notes:
Outdoor Air EPC = Soil EPC (See Table 4)/PEF.
PEF = Particulate Emission Factor.
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-8 - Area C Risk Calculations
Soil Ingestion, Commercial Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
	RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
Metals										
Arsenic	2.9E+00	2.9E+00	2.8E-06	1.4E-06	9.5E-03	4.7E-03	1.0E-06	1.2E-07	1.5E-06	1.8E-07
			TOTAL HAZARD INDEX		9.E-03	5.E-03	TOTAL CANCER RISK		2.E-06	2.E-07

Notes:
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-8 - Area C Risk Calculations
Dermal Contact with Soil, Commercial Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	ABS	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
Metals											
Arsenic	0.03	2.9E+00	2.9E+00	2.8E-07	2.2E-07	9.3E-04	7.3E-04	1.0E-07	1.9E-08	1.5E-07	2.8E-08
				TOTAL HAZARD INDEX		9.E-04	7.E-04	TOTAL CANCER RISK		1.E-07	3.E-08

Notes:
ABS = Dermal Absorption Factor (EPA, 1998).
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-8 - Area C Risk Calculations
Fugitive Dust Inhalation (Outdoor Air), Commercial Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	PEF in m^3/kg	Outdoor Air EPC in mg/m^3		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
Metals											
Arsenic	1.32E+09	2.2E-09	2.2E-09	3.3E-10	3.3E-10	–	–	1.2E-10	2.8E-11	1.8E-09	4.2E-10
				TOTAL HAZARD INDEX		0.E+00	0.E+00	TOTAL CANCER RISK		2.E-09	4.E-10

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Notes:
Outdoor Air EPC = Soil EPC (See Table 4)/PEF.
PEF = Particulate Emission Factor.
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-8 - Area C Risk Calculations
Soil Ingestion, Commercial Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
	RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
Metals										
Arsenic	2.9E+00	2.9E+00	2.8E-06	1.4E-06	9.5E-03	4.7E-03	1.0E-06	1.2E-07	1.5E-06	1.8E-07
			TOTAL HAZARD INDEX		**9.E-03**	**5.E-03**	**TOTAL CANCER RISK**		**2.E-06**	**2.E-07**

Notes:
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

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Table B-8 - Area C Risk Calculations
Dermal Contact with Soil, Commercial Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	ABS	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
Metals											
Arsenic	0.03	2.9E+00	2.9E+00	2.8E-07	2.2E-07	9.3E-04	7.3E-04	1.0E-07	1.9E-08	1.5E-07	2.8E-08
				TOTAL HAZARD INDEX		9.E-04	7.E-04	TOTAL CANCER RISK		1.E-07	3.E-08

Notes:
ABS = Dermal Absorption Factor (EPA, 1998).
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-8 - Area C Risk Calculations
Fugitive Dust Inhalation (Outdoor Air), Commercial Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	PEF in m^3/kg	Outdoor Air EPC in mg/m^3		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
Metals											
Arsenic	1.32E+09	2.2E-09	2.2E-09	3.3E-10	3.3E-10	--	--	1.2E-10	2.8E-11	1.8E-09	4.2E-10
				TOTAL HAZARD INDEX		0.E+00	0.E+00	TOTAL CANCER RISK		2.E-09	4.E-10

F:\DATA\Jobs\Port of Portland\15191-01 T-1 Risk Assessment\Appendicies\Appendix B Tables\B-8

Notes:
Outdoor Air EPC = Soil EPC (See Table 4)/PEF.
PEF = Particulate Emission Factor.
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-9 - Area C Risk Calculations
Soil Ingestion, Excavation Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
	RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
Metals										
Arsenic	1.2E+01	5.8E+00	2.0E-06	2.0E-07	6.8E-03	6.8E-04	2.9E-08	1.5E-09	4.3E-08	2.2E-09
			TOTAL HAZARD INDEX		**7.E-03**	**7.E-04**	**TOTAL CANCER RISK**		**4.E-08**	**2.E-09**

Notes:
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-9 - Area C Risk Calculations
Dermal Contact with Soil, Excavation Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	ABS	Soil EPC in mg/kg		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
Metals											
Arsenic	0.03	1.2E+01	5.8E+00	5.2E-07	5.9E-08	1.7E-03	2.0E-04	7.4E-09	4.2E-10	1.1E-08	6.3E-10
				TOTAL HAZARD INDEX		2.E-03	2.E-04	TOTAL CANCER RISK		1.E-08	6.E-10

Notes:
ABS = Dermal Absorption Factor (EPA, 1998).
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Table B-9 - Area C Risk Calculations
Fugitive Dust Inhalation (Outdoor Air), Excavation Worker
Marine Terminal 1 South Risk Assessment
Portland, Oregon

Compounds of Potential Concern	PEF in m^3/kg	Outdoor Air EPC in mg/m^3		Hazard Intake in mg/kg-day		Hazard Quotient		Cancer Intake in mg/kg-day		Cancer Risk	
		RME	CT	RME	CT	RME	CT	RME	CT	RME	CT
Metals											
Arsenic	1.3E+09	9.1E-09	4.4E-09	4.9E-11	2.4E-11	--	--	7.0E-13	1.7E-13	1.0E-11	2.5E-12
				TOTAL HAZARD INDEX		0.E+00	0.E+00	TOTAL CANCER RISK		1.E-11	3.E-12

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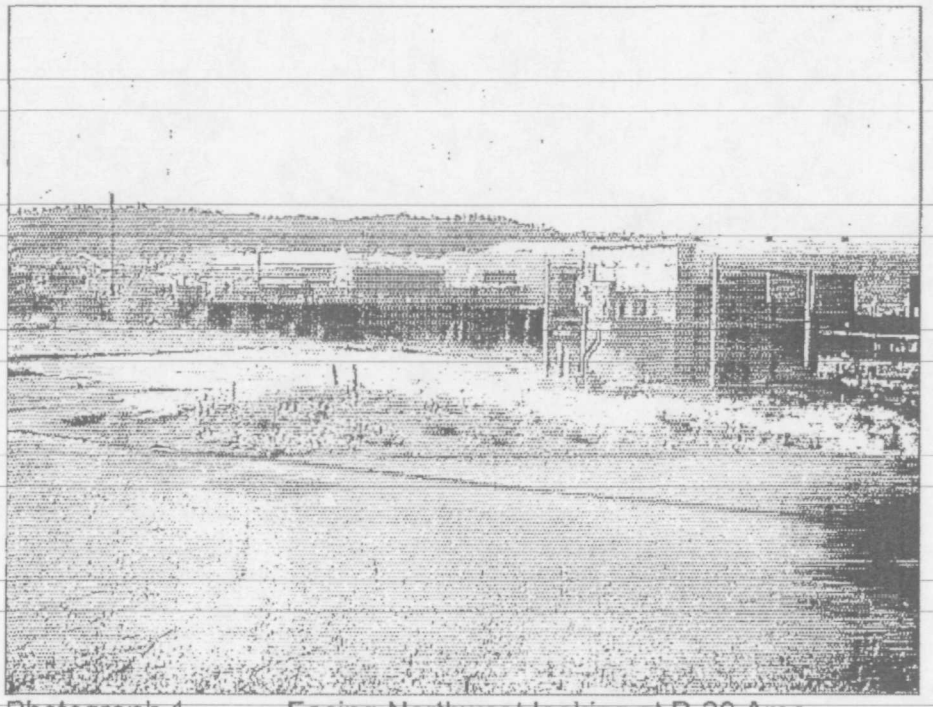
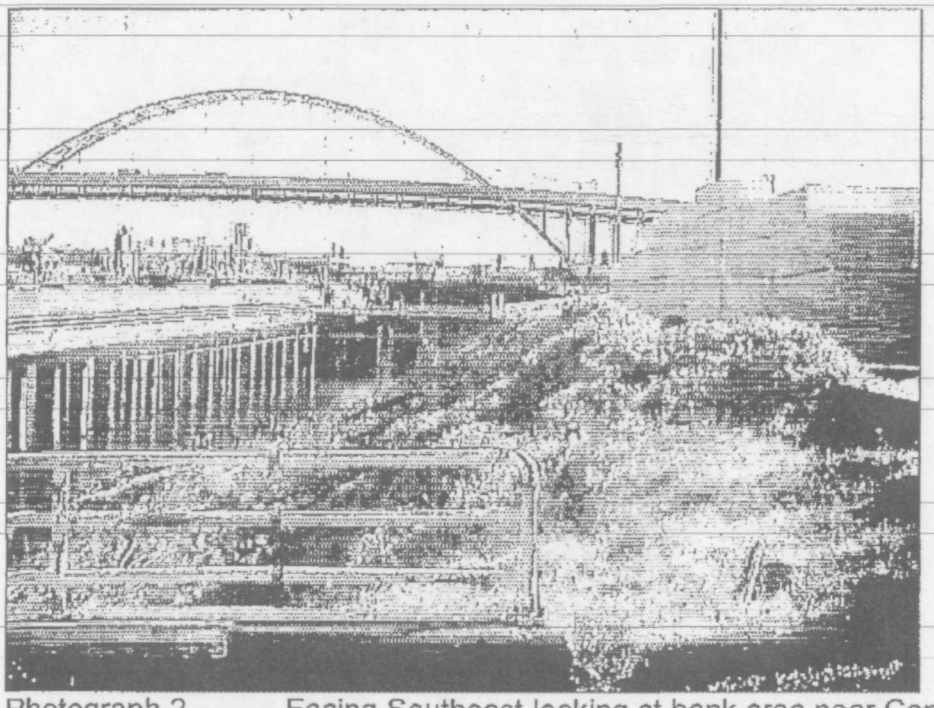
Notes:
Outdoor Air EPC = Soil EPC (See Table 4)/PEF.
PEF = Particulate Emission Factor.
RME = Reasonable Maximum Exposure.
CT = Central Tendency.
EPC = Exposure Point Concentration.

Appendix C

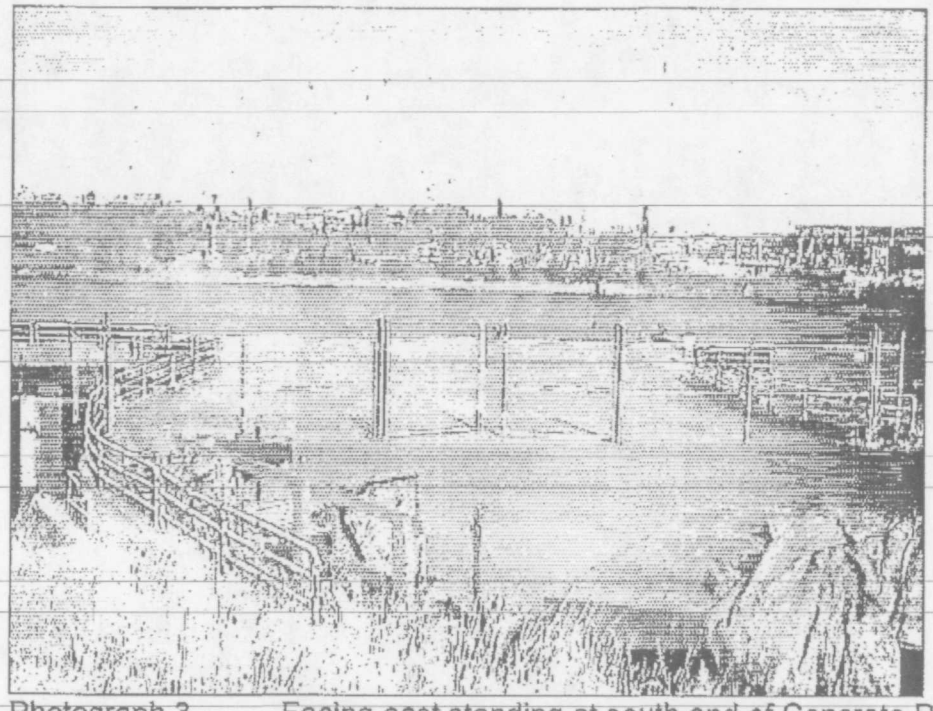
APPENDIX C
PHOTOGRAPHS



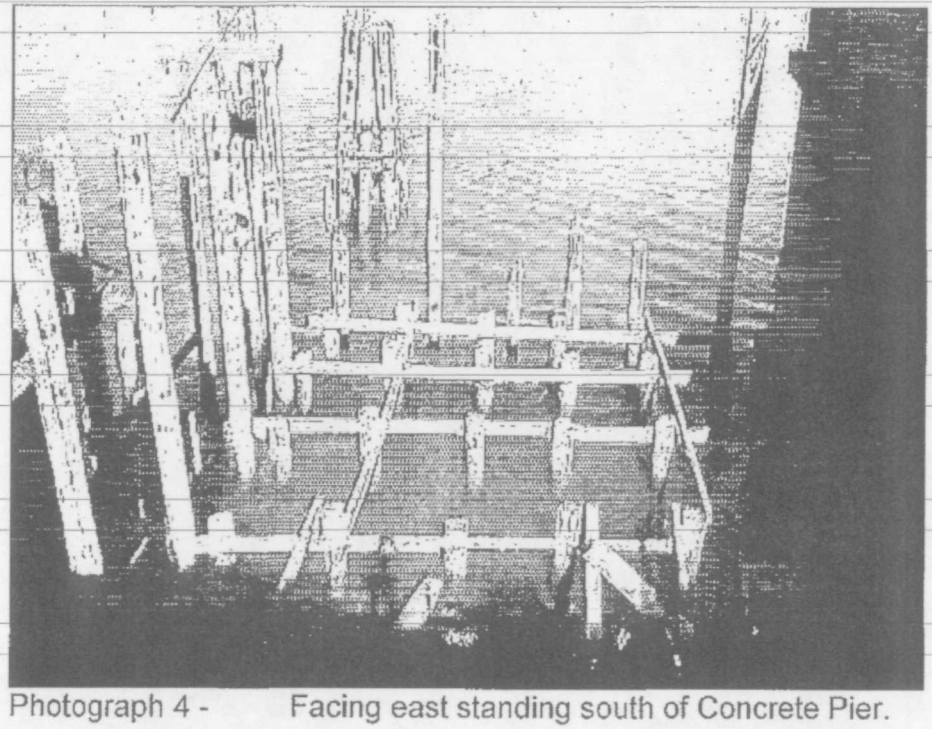
Photograph 1- Facing Northwest looking at B-20 Area.



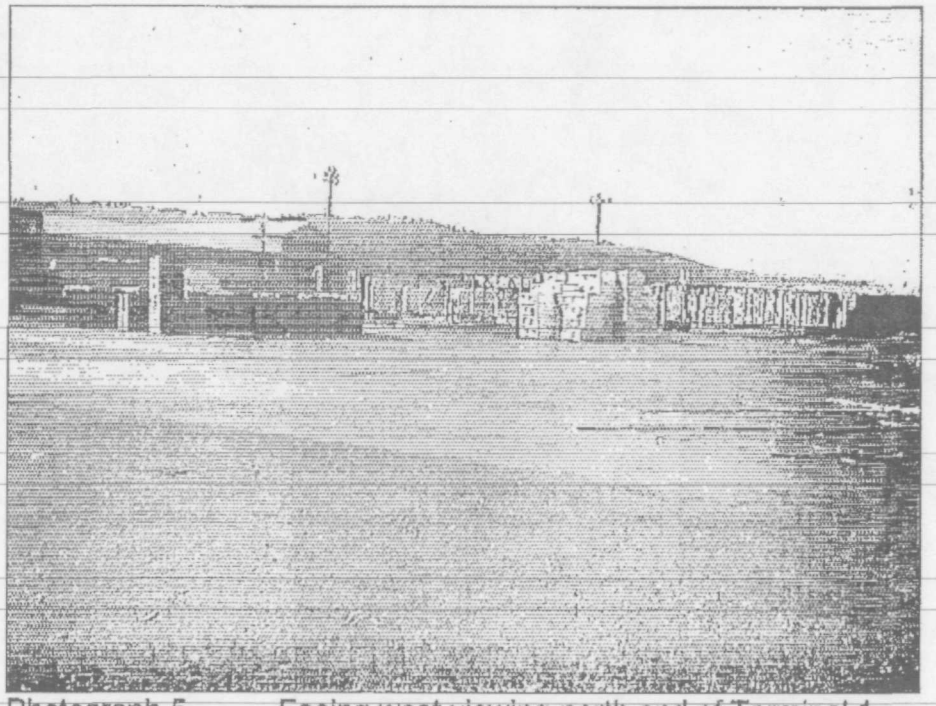
Photograph 2 - Facing Southeast looking at bank area near Concrete Pier.



Photograph 3 - Facing east standing at south end of Concrete Pier.

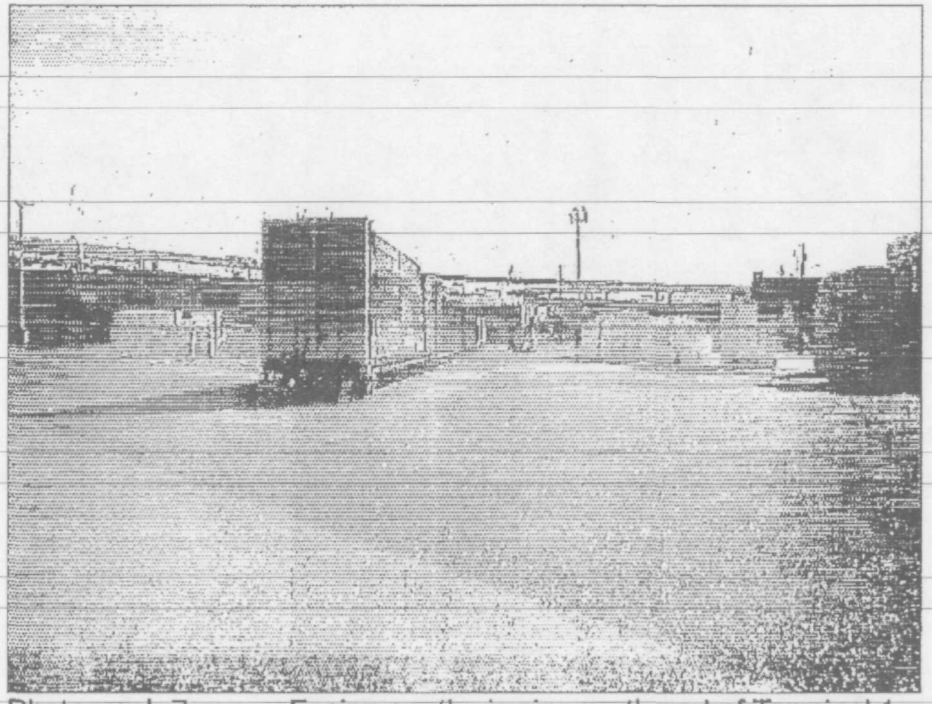


Photograph 4 - Facing east standing south of Concrete Pier.

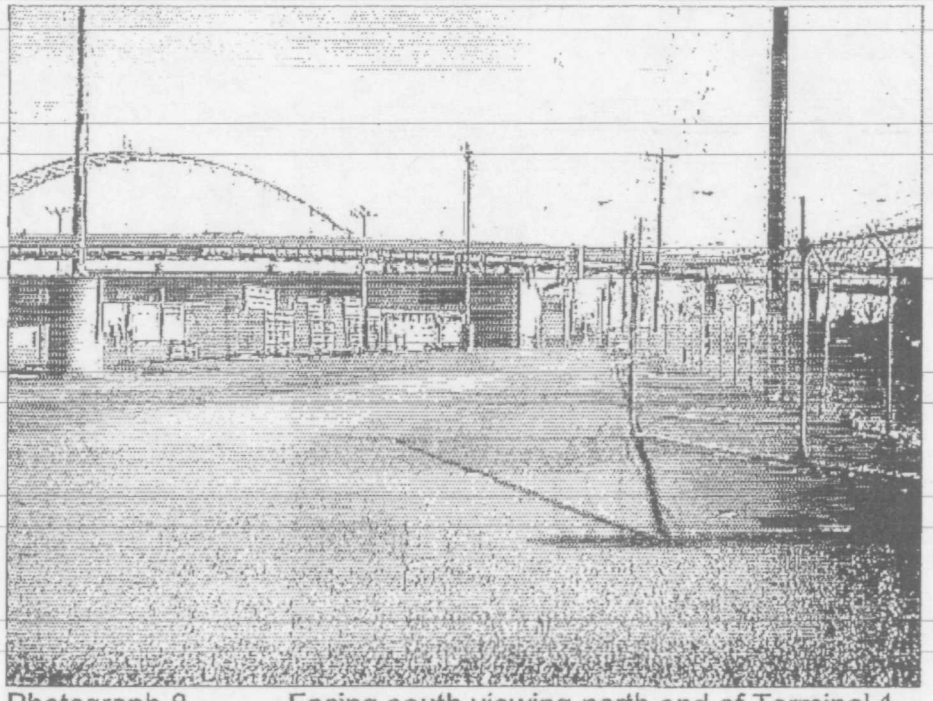


Photograph 5 - Facing west viewing north end of Terminal 1.

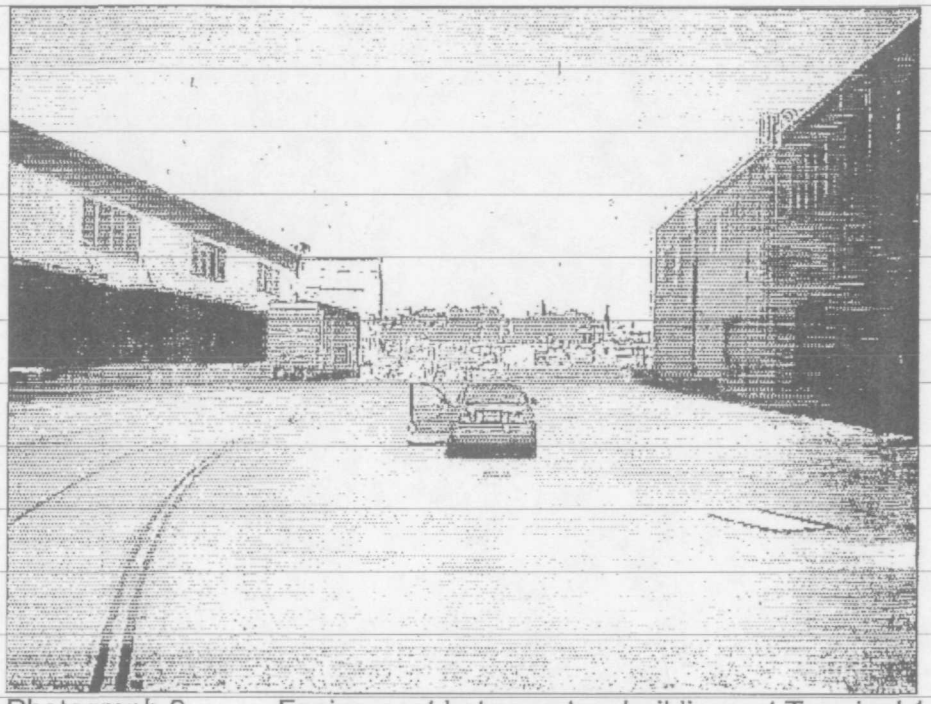
Photograph 6 - Facing southwest viewing north end of Terminal 1.



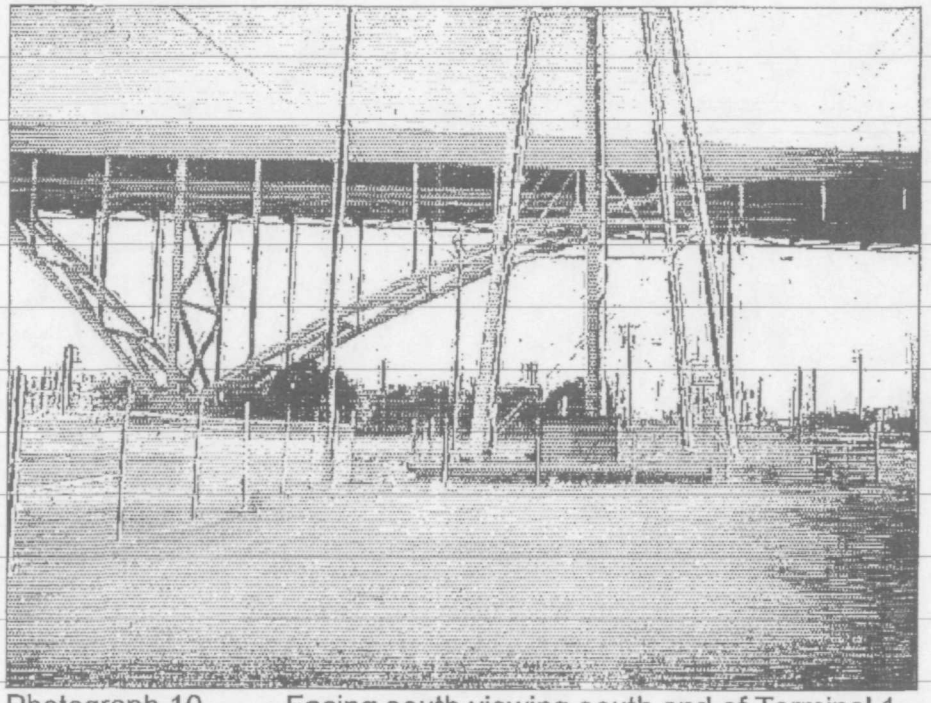
Photograph 7 - Facing south viewing north end of Terminal 1.



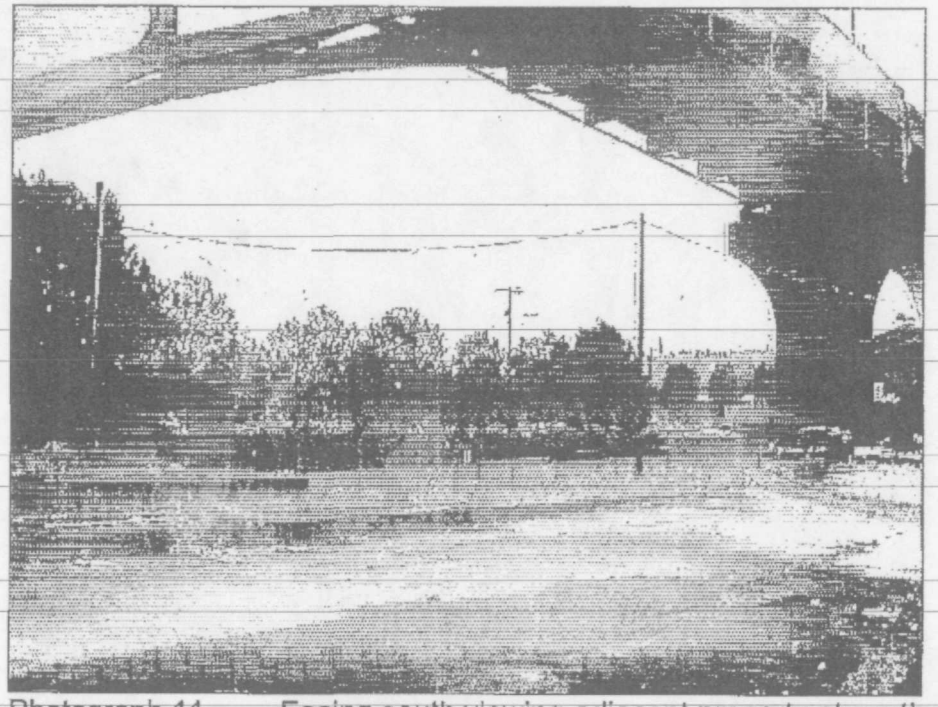
Photograph 8 - Facing south viewing north end of Terminal 1.



Photograph 9 - Facing east between two buildings at Terminal 1.

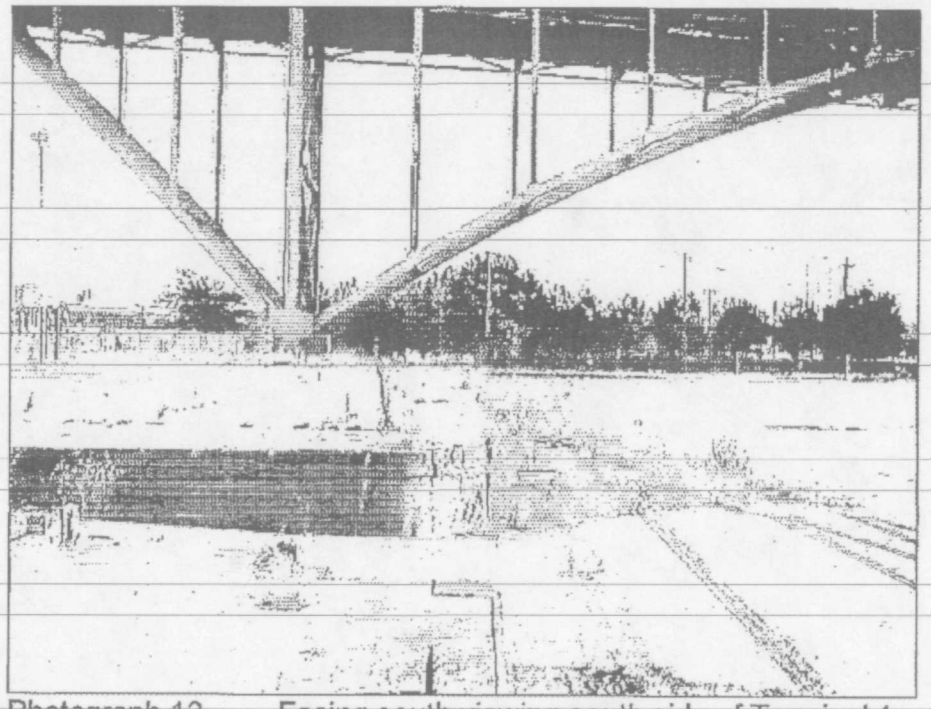


Photograph 10 - Facing south viewing south end of Terminal 1.

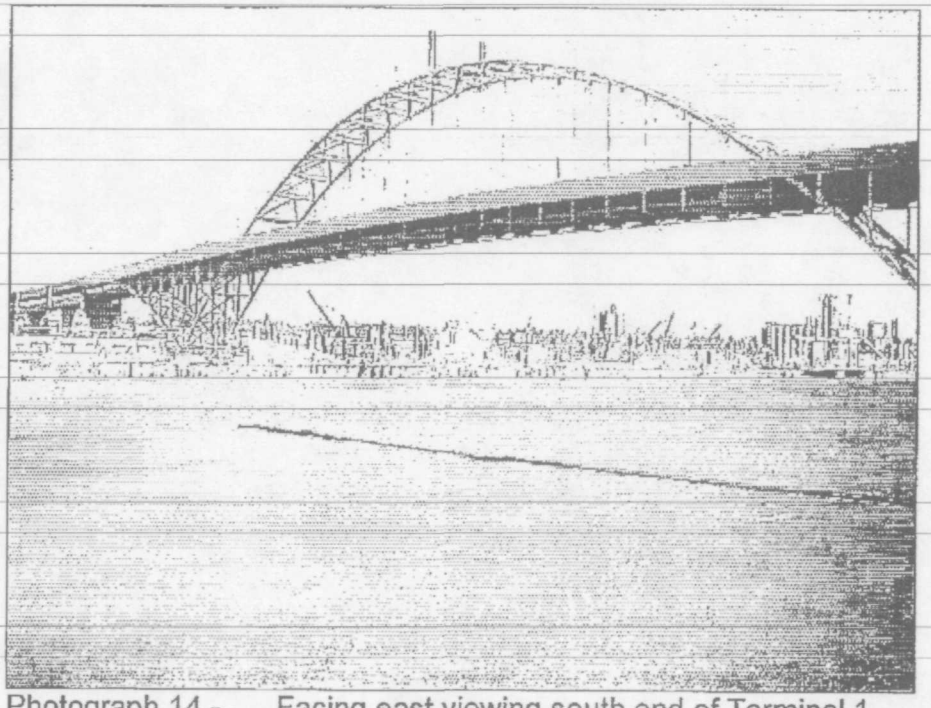


Photograph 11 - Facing south viewing adjacent property at south end of Terminal 1.

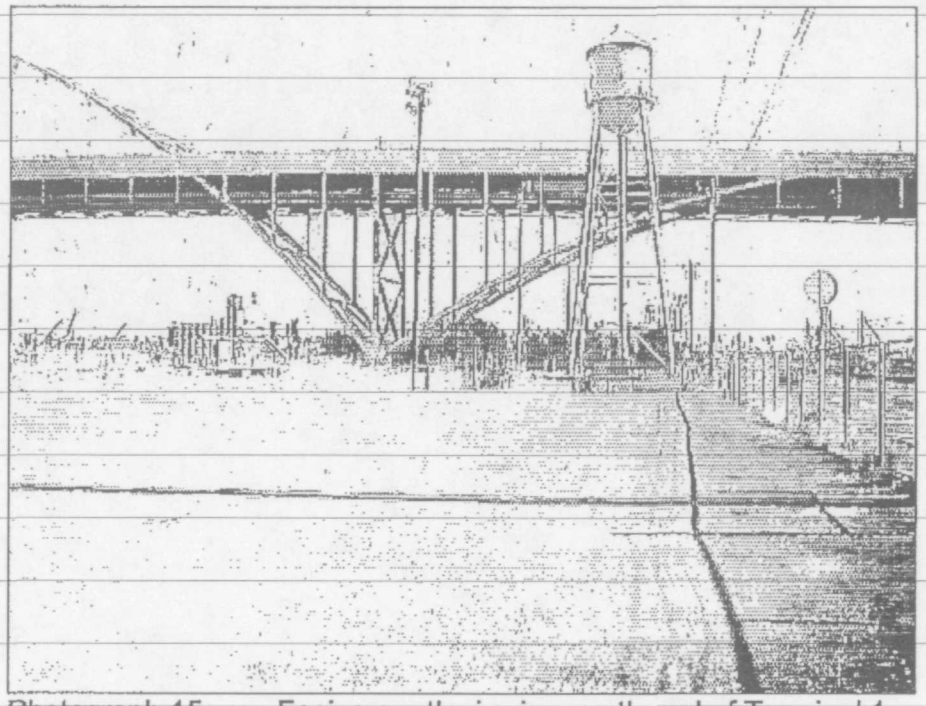
Photograph 12 - Facing north viewing south building on south side of Terminal 1.



Photograph 13 - Facing south viewing south side of Terminal 1.



Photograph 14 - Facing east viewing south end of Terminal 1.



Photograph 15 - Facing south viewing south end of Terminal 1.

Appendix D

APPENDIX D
DEQ ECOLOGICAL SCOPING CHECKLIST

ATTACHMENT 1
Ecological Scoping Checklist

Site Name	Terminal 1 South
Date of Site Visit	October 2, 2001
Site Location	2100 NW Front Avenue along the Willamette River in Portland, Oregon
Site Visit Conducted by	Keith A. Kroeger

Part ❶

CONTAMINANTS OF INTEREST Types, Classes, Or Specific Hazardous Substances ‡ Known Or Suspected	Onsite	Adjacent to or in locality of the facility †
Total Petroleum Hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), and metals.	X	

‡ As defined by OAR 340-122-115(30) † As defined by OAR 340-122-115(34)

Part ❷

OBSERVED IMPACTS ASSOCIATED WITH THE SITE	Finding
Onsite vegetation (None, Limited, Extensive)	N
Vegetation in the locality of the site (None, Limited, Extensive)	N
Onsite wildlife such as macroinvertebrates, reptiles, amphibians, birds, mammals, other (None, Limited, Extensive)	N
Wildlife such as macroinvertebrates, reptiles, amphibians, birds, mammals, other in the locality of the site (None, Limited, Extensive)	N
Other readily observable impacts (None, Discuss below)	N
Discussion:	

ATTACHMENT 1
Ecological Scoping Checklist (cont'd)

Part 3

SPECIFIC EVALUATION OF ECOLOGICAL RECEPTORS / HABITAT	Finding
Terrestrial - Wooded	
Percentage of site that is wooded	0
Dominant vegetation type (Evergreen, Deciduous, Mixed)	P *
Prominent tree size at breast height, i.e., four feet (<6", 6" to 12", >12")	
Evidence / observation of wildlife (Macroinvertebrates, Reptiles, Amphibians, Birds, Mammals, Other)	
Terrestrial - Scrub/Shrub/Grasses	
Percentage of site that is scrub/shrub	<1%
Dominant vegetation type (Scrub, Shrub, Grasses, Other)	Weed
Prominent height of vegetation (<2', 2' to 5', >5')	<2'
Density of vegetation (Dense, Patchy, Sparse)	S
Evidence / observation of wildlife (Macroinvertebrates, Reptiles, Amphibians, Birds, Mammals, Other)	B
Terrestrial - Ruderal	
Percentage of site that is ruderal	99%
Dominant vegetation type (Landscaped, Agriculture, Bare ground)	B (paved)
Prominent height of vegetation (0', >0' to <2', 2' to 5', >5')	0'
Density of vegetation (Dense, Patchy, Sparse)	S
Evidence / observation of wildlife (Macroinvertebrates, Reptiles, Amphibians, Birds, Mammals, Other)	B
Aquatic - Non-flowing (lentic)	
Percentage of site that is covered by lakes or ponds	0%
Type of water bodies (Lakes, Ponds, Vernal pools, Impoundments, Lagoon, Reservoir, Canal)	
Size (acres), average depth (feet), trophic status of water bodies	
Source water (River, Stream, Groundwater, Industrial discharge, Surface water runoff)	
Water discharge point (None, River, Stream, Groundwater, Wetlands impoundment)	
Nature of bottom (Muddy, Rocky, Sand, Concrete, Other)	
Vegetation present (Submerged, Emergent, Floating)	
Obvious wetlands present (Yes / No)	
Evidence / observation of wildlife (Macroinvertebrates, Reptiles, Amphibians, Birds, Mammals, Other)	
Aquatic - Flowing (lotic)	
Percentage of site that is covered by rivers, streams (brooks, creeks), intermittent streams, dry wash, arroyo, ditches, or channel waterway	0%
Type of water bodies (Rivers, Streams, Intermittent Streams, Dry wash, Arroyo, Ditches, Channel waterway)	
Size (acres), average depth (feet), approximate flow rate (cfs) of water bodies	
Bank environment (cover: Vegetated, Bare / slope: Steep, Gradual / height (in feet))	
Source water (River, Stream, Groundwater, Industrial discharge, Surface water runoff)	
Tidal influence (Yes / No)	
Water discharge point (None, River, Stream, Groundwater, Wetlands impoundment)	
Nature of bottom (Muddy, Rocky, Sand, Concrete, Other)	

SPECIFIC EVALUATION OF ECOLOGICAL RECEPTORS / HABITAT	Finding
Vegetation present (Submerged, Emergent, Floating)	
Obvious wetlands present (Yes / No)	
Evidence / observation of wildlife (Macroinvertebrates, Reptiles, Amphibians, Birds, Mammals, Other)	
Aquatic - Wetlands	
Obvious or designated wetlands present (Yes / No)	N
Wetlands suspected as site is/has (Adjacent to water body, in Floodplain, Standing water, Dark wet soils, Mud cracks, Debris line, Water marks)	
Vegetation present (Submerged, Emergent, Scrub/shrub, Wooded)	
Size (acres) and depth (feet) of suspected wetlands	
Source water (River, Stream, Groundwater, Industrial discharge, Surface water runoff)	
Water discharge point (None, River, Stream, Groundwater, Impoundment)	
Tidal influence (Yes / No)	
Evidence / observation of wildlife (Macroinvertebrates, Reptiles, Amphibians, Birds, Mammals, Other)	

* P: Photographic documentation of these features is highly recommended.

Part ❹

ECOLOGICALLY IMPORTANT SPECIES / HABITATS OBSERVED
Terminal 1 South is located adjacent to the Willamette River, which is habitat for Coastal cutthroat trout (proposed threatened), Coho salmon (candidate), Steelhead (threatened), and Chinook salmon (threatened).

ATTACHMENT 2
Evaluation of Receptor-Pathway Interactions

EVALUATION OF RECEPTOR-PATHWAY INTERACTIONS	Y	N	U
Are hazardous substances present or potentially present in surface waters?		N	
AND			
Are ecologically important species or habitats present?	Y		
AND			
Could hazardous substances reach these receptors via surface water?		N	
When answering the above questions, consider the following:			
• Known or suspected presence of hazardous substances in surface waters.			
• Ability of hazardous substances to migrate to surface waters.			
• Terrestrial organisms may be dermally exposed to water-borne contaminants as a result of wading or swimming in contaminated waters. Aquatic receptors may be exposed through osmotic exchange, respiration or ventilation of surface waters.			
• Contaminants may be taken-up by terrestrial plants whose roots are in contact with surface waters.			
• Terrestrial receptors may ingest water-borne contaminants if contaminated surface waters are used as a drinking water source.			
Are hazardous substances present or potentially present in groundwater?		N	
AND			
Are ecologically important species or habitats present?	Y		
AND			
Could hazardous substances reach these receptors via groundwater?		N	
When answering the above questions, consider the following:			
• Known or suspected presence of hazardous substances in groundwater.			
• Ability of hazardous substances to migrate to groundwater.			
• Potential for hazardous substances to migrate via groundwater and discharge into habitats and/or surface waters.			
• Contaminants may be taken-up by terrestrial and rooted aquatic plants whose roots are in contact with groundwater present within the root zone (~1m depth).			
• Terrestrial wildlife receptors generally will not contact groundwater unless it is discharged to the surface.			

"Y" = yes; "N" = No, "U" = Unknown (counts as a "Y")

ATTACHMENT 2
Evaluation of Receptor-Pathway Interactions (cont'd)

EVALUATION OF RECEPTOR-PATHWAY INTERACTIONS	Y	N	U
Are hazardous substances present or potentially present in sediments?		N	
AND			
Are ecologically important species or habitats present?	Y		
AND			
Could hazardous substances reach these receptors via contact with sediments?		N	
When answering the above questions, consider the following:			
• Known or suspected presence of hazardous substances in sediment.			
• Ability of hazardous substances to leach or erode from surface soils and be carried into sediment via surface runoff.			
• Potential for contaminated groundwater to upwell through, and deposit contaminants in, sediments.			
• If sediments are present in an area that is only periodically inundated with water, terrestrial species may be dermally exposed during dry periods. Aquatic receptors may be directly exposed to sediments or may be exposed through osmotic exchange, respiration or ventilation of sediment pore waters.			
• Terrestrial plants may be exposed to sediment in an area that is only periodically inundated with water.			
• If sediments are present in an area that is only periodically inundated with water, terrestrial species may have direct access to sediments for the purposes of incidental ingestion. Aquatic receptors may regularly or incidentally ingest sediment while foraging.			
Are hazardous substances present or potentially present in prey or food items of ecologically important receptors?		N	
AND			
Are ecologically important species or habitats present?	Y		
AND			
Could hazardous substances reach these receptors via consumption of food items?		N	
When answering the above questions, consider the following:			
• Higher trophic level terrestrial and aquatic consumers and predators may be exposed through consumption of contaminated food sources.			
• In general, organic contaminants with log $K_{ow} > 3.5$ may accumulate in terrestrial mammals and those with a log $K_{ow} > 5$ may accumulate in aquatic vertebrates.			

"Y" = yes; "N" = No, "U" = Unknown (counts as a "Y")

ATTACHMENT 2
Evaluation of Receptor-Pathway Interactions (cont'd)

EVALUATION OF RECEPTOR-PATHWAY INTERACTIONS	Y	N	U
Are hazardous substances present or potentially present in surficial soils?	Y		
AND			
Are ecologically important species or habitats present?		N	
AND			
Could hazardous substances reach these receptors via incidental ingestion of or dermal contact with surficial soils?		N	
When answering the above questions, consider the following:			
• Known or suspected presence of hazardous substances in surficial (~1m depth) soils.			
• Ability of hazardous substances to migrate to surficial soils.			
• Significant exposure via dermal contact would generally be limited to organic contaminants which are lipophilic and can cross epidermal barriers.			
• Exposure of terrestrial plants to contaminants present in particulates deposited on leaf and stem surfaces by rain striking contaminated soils (i.e., rain splash).			
• Contaminants in bulk soil may partition into soil solution, making them available to roots.			
• Incidental ingestion of contaminated soil could occur while animals grub for food resident in the soil, feed on plant matter covered with contaminated soil or while grooming themselves clean of soil.			
Are hazardous substances present or potentially present in soils?	Y		
AND			
Are ecologically important species or habitats present?		N	
AND			
Could hazardous substances reach these receptors via vapors or fugitive dust carried in surface air or confined in burrows?		N	
When answering the above questions, consider the following:			
• Volatility of the hazardous substance (volatile chemicals generally have Henry's Law constant > 10^{-5} atm-m^3/mol and molecular weight < 200 g/mol).			
• Exposure via inhalation is most important to organisms that burrow in contaminated soils, given the limited amounts of air present to dilute vapors and an absence of air movement to disperse gases.			
• Exposure via inhalation of fugitive dust is particularly applicable to ground-dwelling species that could be exposed to dust disturbed by their foraging or burrowing activities or by wind movement.			
• Foliar uptake of organic vapors would be limited to those contaminants with relatively high vapor pressures.			
• Exposure of terrestrial plants to contaminants present in particulates deposited on leaf and stem surfaces.			

"Y" = yes; "N" = No, "U" = Unknown (counts as a "Y")

Appendix E

APPENDIX E
OREGON NATURAL HERITAGE PROGRAM CORRESPONDENCE

Oregon NATURAL HERITAGE PROGRAM

A Cooperative Project of :

The Nature Conservancy.

September 7, 2001

Taku Fuji, Ph.D.
Hart Crowser, Inc.
Five Centerpointe Drive, Suite 240
Lake Oswego, OR 97035-8652

1322 SE Morrison Street
Portland, OR 97214-2423
VOICE/FAX (503) 731-3070

Dear Dr. Fuji:

Thank you for requesting information from the Oregon Natural Heritage Program (ONHP). We have conducted a data system search for rare, threatened and endangered plant and animal records for your Port of Portland Terminal 1 South Project (15191-01) in Township 1 North, Range 1 East, Section 28.

~~Fourteen (14) records were noted within a two-mile radius of your project and are included on the enclosed computer printout. A key to the fields is also included.~~

Please remember that the lack of rare element information from a given area does not mean that there are no significant elements there, only that there is no information known to us from the site. To assure that there are no important elements present, you should inventory the site, at the appropriate season.

Please note that at this time ONHP does not have comprehensive computerized records available for all anadromous fish in Oregon. I have listed below the species that may be present within the waterways contained in the project area. I have also included their listing by the National Marine Fisheries Service (NMFS). For more information on anadromous fish you may wish to contact NMFS at: 525 NE Oregon Street, Portland, Oregon 97232-2737. Please also note that the U.S. Fish and Wildlife Service now has jurisdiction over coastal cutthroat trout.

~~Coastal cutthroat trout (Columbia River/SW Washington)~~	~~*Oncorhynchus clarki clarki*~~	~~Proposed Threatened~~
Coho salmon (Lower Columbia River)	*Oncorhynchus kisutch*	Candidate
~~Steelhead (Lower Columbia River)~~	~~*Oncorhynchus mykiss*~~	~~Threatened~~
~~Steelhead (Upper Willamette River)~~	~~*Oncorhynchus mykiss*~~	~~Threatened~~
Chinook salmon (Lower Columbia River)	*Oncorhynchus tshawytscha*	Threatened
Chinook salmon (Upper Willamette River)	*Oncorhynchus tshawytscha*	Threatened

~~This data is confidential and for the specific purposes of your project and is **not to be distributed**.~~

If you need additional information or have any questions, please do not hesitate to contact me.

Sincerely,

Cliff Alton
Conservation Information Assistant

encl.: invoice
computer printout and data key

NAME: FALCO PEREGRINUS ANATUM
COMMON NAME: AMERICAN PEREGRINE FALCON
EO-CODE: ABNKD06071*013 LAST OBS: 1997 FED STATUS:
COUNTY(s): MULTNOMAH FIRST OBS: 1994 STATE STATUS: LE
QUAD NAMES: PORTLAND LAT: xxxxxxN SIZE:
PHYSIOGRAPHIC PROV: HV LONG: xxxxxxxW MINELEV (Feet): 50
T-R-S: 001N001E xx QUADCODE: 4512256 MAXELEV (Feet):
T-R-S COMMENTS: Data Blocked, see "DIRECTIONS" PRECISION: S
EO-RANK/COMM: D :
DIRECTIONS: Contact Oregon Natural Heritage Program (503) 731-3070
DESCRIPTION:
EO-DATA: NEST SITE. SEE ANNOBS.
EOTYPE: BREEDING SITE
COMMENTS:
ANNUAL OBSERVATION: 1997-NESTING OBSERVED
1996-2 ADULTS, AT LEAST 2 CHICKS
1995-2 ADULTS, 1 YOUNG FLEDGED
1994-2 ADULTS, 1 YOUNG FLEDGED
OWNER: STATE
MANAGED AREA: STATE HIGHWAY MAINTENANCE DIST 2B
MANAGE COMM:
PROT COMM:
BEST SOURCE: NUGENT, MARTIN. ODFW.

NAME: ONCORHYNCHUS KISUTCH POP 1
COMMON NAME: COHO SALMON (LOWER COLUMBIA RIVER/SW WASHINGTON COAST RUNS)
EO-CODE: AFCHA02031*037 LAST OBS: 1999-PRE FED STATUS: C
COUNTY(s): COLUMBIA FIRST OBS: STATE STATUS: LE
MULTNOMAH
CLACKAMAS
QUAD NAMES: OREGON CITY LAT: SIZE:
GLADSTONE
LAKE OSWEGO
PORTLAND
LINNTON
SAUVIE ISLAND
ST HELENS
PHYSIOGRAPHIC PROV: LONG: MINELEV (Feet):
T-R-S: QUADCODE: 4512235 MAXELEV (Feet):
4512245
4512246
4512256
4512257
4512267
4512277
T-R-S COMMENTS: PRECISION: N
EO-RANK/COMM: :
DIRECTIONS: SCAPPOOSE BAY, MULTNOMAH CHANNEL, WILLAMETTE RIVER
DESCRIPTION:
EO-DATA: ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE
EOTYPE: REARING & MIGRATION - fish
COMMENTS: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 1999. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFW'S DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF COHO IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.
ANNUAL OBSERVATION:
OWNER:
MANAGED AREA:
MANAGE COMM:
PROT COMM:
BEST SOURCE: 2000 ODFW GEOGRAPHIC RESOURCES DATA; MASSEY, JAY; BENNETT, DON.

NAME: ONCORHYNCHUS TSHAWYTSCHA POP 21
COMMON NAME: CHINOOK SALMON - LOWER COLUMBIA RIVER SPRING RUN
EO-CODE: AFCHA0205W*006 LAST OBS: 1999-PRE FED STATUS: LT
COUNTY(s): CLACKAMAS FIRST OBS: STATE STATUS:
MULTNOMAH
COLUMBIA
QUAD NAMES: OREGON CITY LAT: SIZE:
GLADSTONE
LAKE OSWEGO
PORTLAND
LINNTON
SAUVIE ISLAND
ST HELENS
PHYSIOGRAPHIC PROV: LONG: MINELEV (Feet):
T-R-S: QUADCODE: 4512235 MAXELEV (Feet):
4512245
4512246
4512256
4512257
4512267
4512277
T-R-S COMMENTS: PRECISION: H
EO-RANK/COMM: :
DIRECTIONS: SCAPPOOSE BAY, MULTNOMAH CHANNEL, WILLAMETTE RIVER
DESCRIPTION:
EO-DATA: SPRING-RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE
EOTYPE: REARING & MIGRATION - fish
COMMENTS: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 1999. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFW'S DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF CHINOOK IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.
ANNUAL OBSERVATION:
OWNER:
MANAGED AREA:
MANAGE COMM:
PROT COMM:
BEST SOURCE: 2000 ODFW GEOGRAPHIC RESOURCES DATA; MASSEY, JAY; BENNETT, DON.

NAME: ONCORHYNCHUS TSHAWYTSCHA POP 22
COMMON NAME: CHINOOK SALMON - LOWER COLUMBIA RIVER FALL RUN
EO-CODE: AFCHA0205Y*006 LAST OBS: 1999-PRE FED STATUS: LT
COUNTY(s): CLACKAMAS FIRST OBS: STATE STATUS: SC
MULTNOMAH
COLUMBIA
QUAD NAMES: OREGON CITY LAT: SIZE:
GLADSTONE
LAKE OSWEGO
PORTLAND
LINNTON
SAUVIE ISLAND
PHYSIOGRAPHIC PROV: LONG: MINELEV (Feet):
T-R-S: QUADCODE: 4512235 MAXELEV (Feet):
4512245
4512246
4512256
4512257
4512267
T-R-S COMMENTS: PRECISION: H
EO-RANK/COMM: :
DIRECTIONS: SCAPPOOSE BAY & TRIBUTARIES, WILLAMETTE RIVER & TRIBUTARIES
DESCRIPTION:

EO-DATA: FALL RUN; ODFW DISTRIBUTION MAPS USED TO CREATE THE 1:24,000 COVERAGE
EOTYPE: REARING & MIGRATION - fish
COMMENTS: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 1999. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFW'S DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF CHINOOK IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.
ANNUAL OBSERVATION:
OWNER:
MANAGED AREA:
MANAGE COMM:
PROT COMM:
BEST SOURCE: 2000 ODFW GEOGRAPHIC RESOURCES DATA; MASSEY, JAY; BENNETT, DON; CALDWELL, DICK.

NAME: ONCORHYNCHUS MYKISS POP 27
COMMON NAME: STEELHEAD - LOWER COLUMBIA RIVER WINTER RUN
EO-CODE: AFCHA02132*001 LAST OBS: 1999-PRE FED STATUS: LT
COUNTY(s): CLACKAMAS FIRST OBS: STATE STATUS: SC
MULTNOMAH
COLUMBIA
QUAD NAMES: OREGON CITY LAT: SIZE:
GLADSTONE
LAKE OSWEGO
PORTLAND
LINNTON
SAUVIE ISLAND
ST HELENS
PHYSIOGRAPHIC PROV: LONG: MINELEV (Feet):
T-R-S: QUADCODE: 4512235 MAXELEV (Feet):
4512245
4512246
4512256
4512257
4512267
4512277
T-R-S COMMENTS: PRECISION: M
EO-RANK/COMM: :
DIRECTIONS: SCAPPOOSE BAY, MULTNOMAH CHANNEL, WILLAMETTE RIVER
DESCRIPTION:
EO-DATA: WINTER RUN: ODFW DISTRIBUTIION MAPS USED TO CREATE THE 1:24,000 COVERAGE
EOTYPE: REARING & MIGRATION - fish
COMMENTS: DISTRIBUTION INFORMATION USED IN THIS EOR WAS DERIVED FROM ODFW GEOGRAPHIC RESOURCES DATA PRODUCED AND DISTRIBUTED IN 1999. UNLESS SPECIFIC DATA EXISTS IN THE DATA FIELD, THE INFORMATION PRESENTED IN THIS EOR REPRESENTS THE "BEST PROFESSIONAL JUDGMENT" BY ODFW'S DISTRICT FISHERIES BIOLOGIST; THE PRESENCE OF STEELHEAD IN DESCRIBED AREAS SHOULD BE CONSIDERED UNDOCUMENTED BUT AS HAVING A POTENTIAL OF BEING PRESENT.
ANNUAL OBSERVATION:
OWNER:
MANAGED AREA:
MANAGE COMM:
PROT COMM:
BEST SOURCE: 2000 ODFW GEOGRAPHIC RESOURCES DATA; MASSEY, JAY; BENNETT, DON.

NAME: CORYNORHINUS TOWNSENDII TOWNSENDII
COMMON NAME: PACIFIC WESTERN BIG-EARED BAT
EO-CODE: AMACC08015*071 LAST OBS: 1928-09-05 FED STATUS: SOC
COUNTY(s): MULTNOMAH FIRST OBS: 1914 STATE STATUS: SC
QUAD NAMES: PORTLAND LAT: 453220N SIZE: 0
PHYSIOGRAPHIC PROV: WV LONG: 1223800W MINELEV (Feet): 150
T-R-S: 001N001E 25 QUADCODE: 4512256 MAXELEV (Feet):
T-R-S COMMENTS: PRECISION: G
EO-RANK/COMM: D :
DIRECTIONS: PORTLAND - ON THE E SIDE

DESCRIPTION:
EO-DATA: ADULT MALE IN THE JEWETT COLLECTION WAS CAPTURED 9-5-20, A FEW MI FROM A CAVE ON THE E SIDE OF PORTLAND THAT WAS USED BY HUNDREDS OF BATS IN 1914, BUT WAS LATER DESTROYED BY VANDALS
EOTYPE:
COMMENTS:
ANNUAL OBSERVATION:
OWNER: PRIVATE
MANAGED AREA:
MANAGE COMM:
PROT COMM:
BEST SOURCE: BAILEY. 1936. MAMMALS OF OREGON. MASSER & CROSS. 1981. NOTES ON THE DISTRIBUTION OF OREGON BATS

NAME: ANTROZOUS PALLIDUS PACIFICUS
COMMON NAME: PACIFIC PALLID BAT
EO-CODE: AMACC10011*016 LAST OBS: 1927-08 FED STATUS: SOC
COUNTY(s): MULTNOMAH FIRST OBS: 1927 STATE STATUS: SV
QUAD NAMES: PORTLAND LAT: 453045N SIZE: 0
PHYSIOGRAPHIC PROV: WV LONG: 1224130W MINELEV (Feet): 150
T-R-S: 001S001E 04 QUADCODE: 4512256 MAXELEV (Feet):
T-R-S COMMENTS: PRECISION: G
EO-RANK/COMM: :
DIRECTIONS: PORTLAND
DESCRIPTION:
EO-DATA: LEO SIMON REPORTED A LARGE NUMBER OF PALLID BATS FLYING AROUND A CHURCH TOWER ON AN EVENING IN MID-AUGUST, 1927. DATE INDICATES A BREEDING COLONY
EOTYPE:
COMMENTS:
ANNUAL OBSERVATION:
OWNER:
MANAGED AREA:
MANAGE COMM:
PROT COMM:
BEST SOURCE: BAILEY. 1936. MAMMALS & LIFE ZONES OF OREGON

NAME: CHRYSEMYS PICTA
COMMON NAME: PAINTED TURTLE
EO-CODE: ARAAD01010*060 LAST OBS: 1991-08-09 FED STATUS:
COUNTY(s): MULTNOMAH FIRST OBS: 1991-08-02 STATE STATUS: SC
QUAD NAMES: PORTLAND LAT: 453141N SIZE:
PHYSIOGRAPHIC PROV: WV LONG: 1224350W MINELEV (Feet): 450
T-R-S: 001N001E 31 QUADCODE: 4512256 MAXELEV (Feet):
T-R-S COMMENTS: SW4NE4 [TRS NOT GIVEN] PRECISION: S
EO-RANK/COMM: C :
DIRECTIONS: PORTLAND AUDUBON SOCIETY POND, 5151 NW CORNELL RD.
DESCRIPTION:
EO-DATA: 1991: 1 INDIVIDUAL OBSERVED.
EOTYPE:
COMMENTS:
ANNUAL OBSERVATION:
OWNER: PRIVATE
MANAGED AREA:
MANAGE COMM:
PROT COMM:
BEST SOURCE: BRUCE, CHARLIE. ODFW.

NAME: CHRYSEMYS PICTA
COMMON NAME: PAINTED TURTLE
EO-CODE: ARAAD01010*061 LAST OBS: 1965-04-10 FED STATUS:
COUNTY(s): MULTNOMAH FIRST OBS: 1965-04-10 STATE STATUS: SC
QUAD NAMES: PORTLAND LAT: 453100N SIZE:
PHYSIOGRAPHIC PROV: WV LONG: 1224253W MINELEV (Feet): 770
T-R-S: 001S001E 5 QUADCODE: 4512256 MAXELEV (Feet):

T-R-S COMMENTS: NW4 (TRS NOT GIVEN) PRECISION: M
EO-RANK/COMM: D :
DIRECTIONS: HOYT PARK, FAIRVIEW BOULEVARD.
DESCRIPTION:
EO-DATA: 1965: 1 INDIVIDUAL COLLECTED
EOTYPE:
COMMENTS: OBSERVER: CAVANAGH, R. PORTLAND STATE UNIVERSITY SPECIMEN #002431.
ANNUAL OBSERVATION:
OWNER: CITY
MANAGED AREA:
MANAGE COMM:
PROT COMM:
BEST SOURCE: BRUCE, CHARLIE. ODFW.

NAME: CLEMMYS MARMORATA MARMORATA
COMMON NAME: NORTHWESTERN POND TURTLE
EO-CODE: ARAAD02031*041 LAST OBS: FED STATUS: SOC
COUNTY(s): MULTNOMAH FIRST OBS: STATE STATUS: SC
QUAD NAMES: PORTLAND LAT: 453045N SIZE: 0
PHYSIOGRAPHIC PROV: WV LONG: 1224130W MINELEV (Feet):
T-R-S: 001S001E 04 QUADCODE: 4512256 MAXELEV (Feet):
T-R-S COMMENTS: PRECISION: G
EO-RANK/COMM: D :
DIRECTIONS: PORTLAND
DESCRIPTION:
EO-DATA: SPECIES RECORDED AT THIS SITE, PER ST. JOHN. DATES NOT SPECIFIED
EOTYPE:
COMMENTS:
ANNUAL OBSERVATION:
OWNER:
MANAGED AREA:
MANAGE COMM:
PROT COMM:
BEST SOURCE: ST. JOHN, ALAN. 1984. HERPETOLOGY OF THE LOWER WILLAMETTE VALLEY

NAME: ASTER CURTUS
COMMON NAME: WHITE-TOPPED ASTER
EO-CODE: PDAST0T0R0*006 LAST OBS: 1898-08 FED STATUS: SOC
COUNTY(s): MULTNOMAH FIRST OBS: 1898 STATE STATUS: LT
QUAD NAMES: PORTLAND LAT: 453045N SIZE: 0
PHYSIOGRAPHIC PROV: WV LONG: 1224130W MINELEV (Feet): 100
T-R-S: 001S001E 04 QUADCODE: 4512256 MAXELEV (Feet):
T-R-S COMMENTS: PRECISION: G
EO-RANK/COMM: :
DIRECTIONS: PORTLAND. NO FURTHER INFORMATION.
DESCRIPTION: NO HABITAT DATA.
EO-DATA: HERBARIUM COLLECTION: NO NAME, 08-09-98, NO #, WS
EOTYPE:
COMMENTS: THIS POPULATION ASSUMED EXTIRPATED.
ANNUAL OBSERVATION:
OWNER:
MANAGED AREA:
MANAGE COMM:
PROT COMM:
BEST SOURCE: HERBARIUM COLLECTION AT WS

NAME: CIMICIFUGA ELATA
COMMON NAME: TALL BUGBANE
EO-CODE: PDRAN07030*017 LAST OBS: 1904-06-30 FED STATUS:
COUNTY(s): MULTNOMAH FIRST OBS: 1882 STATE STATUS: C
QUAD NAMES: PORTLAND LAT: 453045N SIZE:
PHYSIOGRAPHIC PROV: WV LONG: 1224130W MINELEV (Feet):

T-R-S: 001S001E 4 QUADCODE: 4512256 MAXELEV (Feet):
T-R-S COMMENTS: ON OUR TOPO MAP SEC 48 PRECISION: G
EO-RANK/COMM: :
DIRECTIONS: PORTLAND
DESCRIPTION:
EO-DATA: HERBARIUM COLLECTION: HENDERSON S.N., 6-13-82, 6-22-82, ORE; DRAKE AND DICKSON S.N., 5-88, F; DRAKE AND GORMAN 14, 7-4-90, ORE; HOWELL S.N., 6-20-91, MO; GORMAN S.N., 6-30-04, ORE
EOTYPE:
COMMENTS:
ANNUAL OBSERVATION:
OWNER:
MANAGED AREA:
MANAGE COMM:
PROT COMM:
BEST SOURCE: GORMAN COLLECTION

NAME: CIMICIFUGA ELATA
COMMON NAME: TALL BUGBANE
EO-CODE: PDRAN07030*077 LAST OBS: 1993-07-08 FED STATUS:
COUNTY(s): MULTNOMAH FIRST OBS: 1993-07-08 STATE STATUS: C
QUAD NAMES: PORTLAND LAT: 453159N SIZE:
PHYSIOGRAPHIC PROV: WV LONG: 1224252W MINELEV (Feet): 200
T-R-S: 001N001E 32 QUADCODE: 4512256 MAXELEV (Feet):
T-R-S COMMENTS: OUR MAP IT'S SEC 33 PRECISION: M
EO-RANK/COMM: :
DIRECTIONS: FOREST PARK, LOWER MACLEAY TRAIL
DESCRIPTION: TRAILSIDE
EO-DATA: 1 PLANT, BEGINNING TO BLOOM
EOTYPE:
COMMENTS: 1993 PERSONAL COMMUNICATION THROUGH LOIS KEMP
ANNUAL OBSERVATION: 1993-1 PLANT
OWNER: CITY OF PORTLAND
MANAGED AREA:
MANAGE COMM:
PROT COMM:
BEST SOURCE: GUTHRIE, BILL

NAME: CAREX COMOSA
COMMON NAME: BRISTLY SEDGE
EO-CODE: PMCYP032Y0*005 LAST OBS: 1887-03-06 FED STATUS:
COUNTY(s): MULTNOMAH FIRST OBS: 1887-03-06 STATE STATUS:
QUAD NAMES: PORTLAND LAT: 453342N SIZE:
PHYSIOGRAPHIC PROV: WV LONG: 1224243W MINELEV (Feet): 20
T-R-S: 001N001E 20 QUADCODE: 4512250 MAXELEV (Feet):
T-R-S COMMENTS: PRECISION: M
EO-RANK/COMM: :
DIRECTIONS: "[SWAN] ISLAND' [BRACKETED INFORMATION CAME FROM THE CAREX WORKING GROUP-ONHP/SV, 5/97]
DESCRIPTION:
EO-DATA:
EOTYPE:
COMMENTS: HERBARIUM COLLECTION: L.F. HENDERSON, S.N., 3-6-1887, ORE-16644.
ANNUAL OBSERVATION:
OWNER: PRIVATE
MANAGED AREA:
MANAGE COMM:
PROT COMM:
BEST SOURCE: HENDERSON COLLECTION

14 Records listed.

KEY TO PRINTOUT

NAME AND COMMON NAME: The scientific and common name of the species.

EO-CODE (element occurrence code): Unique Heritage Program code for this occurrence. The first 10 characters are the code for the species, and the last 3 are the occurrence number.

COUNTY(S): County name(s)

QUAD NAMES: Name of the USGS 7.5' topographic quadrangle map(s) where the record is mapped.

PHYSIOGRAPHIC PROVINCE: Code for physiographic province.

BM = Ochoco, Blue and Wallowa Mts.	**BR** =Basin and Range
CR = Coast Range	**CB** = Columbia Basin
EC = East slope of the Cascades	**KM** = Klamath Mountains
HP = High Lava Plains	**OU** = Owyhee uplands
WC = West slope and crest of the Cascades	**WV** = Willamette Valley

T-R-S: Township, Range and Section, with township first, range second and section third (a space appears between range and section). 004S029E 32 = Township 4S, Range 29E, Section 32. Fractional townships and ranges are further defined in the T-R COMMENTS field.

T-R-S COMMENTS: Comments relating to township, range or section(s), e.g. SE4NE4 or SENE=SE 1/4 of the NE 1/4

LASTOBS: Last reported sighting date, in the form YYYY-MM-DD

FIRSTOBS: First reported sighting date for this occurrence in the form YYYY-MM-DD

LAT: latitude, North

LONG: longitude, West

QUADCODE: Heritage Program code for the USGS 7.5' topo map

FED STATUS: US Fish and Wildlife Service status

LE = listed endangered	**LT** = listed threatened
PE = proposed endangered	**PT** = proposed threatened
SOC = species of concern	**C** = candidate for listing with enough information available for listing

STATE STATUS: For animals, Oregon Department of Fish and Wildlife status

LE=listed endangered	**PE**=proposed endangered
PT=proposed threatened	**SC** or **C**=sensitive-critical
SV or **V**=sensitive-vulnerable	**SP** or **P**=sensitive peripheral or naturally rare
SU or **U**=sensitive-undetermined.	

SIZE: In acres, whole numbers. 0=unknown

MINELEV: Minimum elevation, in feet.

MAXELEV: Maximum elevation, in feet.

PRECISION: Second (S) = exact location; Minute (M) = location known to nearest 1.5 miles; General (G) = location known to nearest 5 miles.

EO-RANK/COMM: Relative quality of this occurrence (A=best site, B=good population or site, C=fair or small population, D=marginal or destroyed occurrence)

DIRECTIONS: Site name and direction to site

DESCRIPTION: Habitat information, e.g. aspect, slope, soils, associated species, community type, etc.

EO-DATA: Species and population biology - numbers, age, nesting success, vigor, phenology, disease, etc.

EOTYPE: For animals, type of occurrence (e.g. roost, nest, etc.)

COMMENTS: Miscellaneous comments

ANNUAL OBSERVATIONS: Summary of yearly observations

OWNER: federal, state, private, etc.

MANAGED AREA: BLM district, USFS Forest, Private Preserve, etc.

MANAGE COMM: Comments on how the site is managed.

PROT COMM (Protection Comments): Comments regarding protectibility and threats.

BEST SOURCE: Best source of information for this occurrence.

Appendix F

APPENDIX F
CHEMICAL DATA QUALITY REVIEW

APPENDIX F
CHEMICAL DATA QUALITY REVIEW
PORT OF PORTLAND- TERMINAL 1
PORTLAND, OREGON

Hahn and Associates, Inc. (HAI) of Portland, Oregon, submitted soil and water samples to various laboratories for analysis in 1998, 2000, and 2001. The laboratories included Oregon Analytical Laboratory (OAL) of Beaverton, Oregon; North Creek Analytical, Inc. (NCA) of Portland, Oregon; and Environmental Services Laboratory, Inc. (ESL) of Portland, Oregon. Hart Crowser has performed cursory reviews of laboratory data compiled by HAI in Volumes 1 and 2 of a document titled "Terminal 1 South Remedial Investigation Report" and the "Monitoring Well Installation and Groundwater Sampling Report".

The following criteria were evaluated in the data quality review process:

- Holding times;
- Method blanks;
- Surrogate recoveries;
- Laboratory control sample/laboratory control sample duplicate (LCS/LCSD) recoveries;
- Matrix spike/matrix spike duplicate (MS/MSD) recoveries; and
- Laboratory and field duplicate relative percent difference (RPD).

The review is organized by the Appendix containing the data, and is further subdivided by laboratory.

Appendix A: Focused Environmental Site Assessment (August 1998)

NCA ID No. P803593

Twenty-two soil samples were submitted to the laboratory. The following analyses were performed on one or more samples:

- Hydrocarbon Identification (modified EPA Method 8015);
- Total Metals (EPA 6000/7000 Series Methods);
- Phenols (EPA Method 8040A);

- Organochlorine Pesticides (EPA Method 8081);
- Polychlorinated Biphenyls (PCBs, EPA Method 8081);
- Volatile Organic Compounds (VOCs, EPA Method 8260A);
- Chlorinated Herbicides (EPA Method 8151A); and
- Total Petroleum Hydrocarbon (TPH) as Diesel/Oil (NWTPH-Dx).

Hydrocarbon Identification. All required holding times were met. No method blank contamination was detected. Surrogate recoveries were acceptable. No duplicate results were provided.

Total Metals. All required holding times were met. No method blank contamination was detected. LCS and MS recoveries were within laboratory control limits with the following exception from Batch 0380703. Antimony MS recovery 26 percent was less than control limits (75 to 125 percent), associated antimony results, which were all nondetect, were flagged as estimated ("UJ"). Laboratory duplicate RPDs were acceptable with the following exceptions for Batch 0380703. Selenium was detected in the laboratory duplicate, but was not detected in the original sample. However, since the laboratory duplicate result is less than five times the sample reporting limit, no qualification was necessary. The duplicate RPD for arsenic (68.2 percent) exceeded the control limit of 40 percent. Associated arsenic results were flagged as estimated ("J"). No field duplicates were identified.

Phenols. All required holding times were met. No method blank contamination was detected. Surrogate and LCS recoveries were within laboratory control limits with the following exceptions. The LCS recoveries for 4-chloro-3-methylphenol, 2-chlorophenol, and phenol were greater than control limits, while the LCS duplicate recovery for 4-nitrophenol was greater than the control limit. The LCS duplicate RPDs were acceptable. Since no phenolic compounds were detected, no qualifiers were necessary. No field duplicates were identified.

Organochlorine Pesticides. All required holding times were met. No method blank contamination was detected. Surrogate, LCS, and MS recoveries were within laboratory control limits. MS/MSD RPDs were not calculated since the MSD sample extract was lost during the GPC procedure. No field duplicates were identified.

PCBs. All required holding times were met. No method blank contamination was detected. Surrogate, LCS, and MS recoveries were within laboratory control limits. MS/MSD RPDs were acceptable. No field duplicates were identified.

VOCs. All required holding times were met. No method blank contamination was detected. Surrogate, LCS, and MS recoveries were within laboratory control limits. MS/MSD RPDs were acceptable. No field duplicates were identified.

Chlorinated Herbicides. All required holding times were met. No method blank contamination was detected. Surrogate and LCS recoveries were within laboratory control limits. LCS duplicate RPDs were acceptable. No field duplicates were identified.

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. Surrogate and LCS recoveries were within laboratory control limits with the following exception. The surrogate recovery for sample T-1 B-5 0-2 was not recoverable due to sample dilution. No qualification was necessary. Laboratory duplicate RPDs were acceptable. No field duplicates were identified.

Appendix I: Baseline Soil Samples (February and March 2000)

Sample No. Prefix: 4976-000229
OAL ID No. L153236

Twenty-nine soil samples were submitted to the laboratory. The following analyses were performed on one or more samples:

- Total Metals (EPA 6000/7000 Series Methods);
- Benzene, Toluene, Ethylbenzene, and Xylene (BTEX, EPA Method 8260);
- Volatile Organic Compounds (VOCs, EPA Method 8260);
- TPH Identification (NWTPH-HCID);
- PCBs (EPA Method 8082);
- Polynuclear Aromatic Hydrocarbons (PAHs, EPA Method 8270 SIM); and
- TPH as Diesel/Oil (NWTPH-Dx).

Total Metals. All required holding times were met. No method blank contamination was detected. LCS and MS recoveries were within laboratory control limits with the following exception. Antimony MS recovery was 72 percent versus the control limit of 75 to 125 percent. Associated antimony results, which were all nondetect, were flagged "UJ". The MS recovery for lead was less than the control limit for sample -020; however, since the spike amount was less than four times the sample result, no qualification was

necessary. Laboratory duplicate RPDs were acceptable. No field duplicates were identified.

BTEX. All required holding times were met. No method blank contamination was detected. Surrogate, LCS, and MS recoveries were within laboratory control limits. MS/MSD duplicate RPDs were acceptable. The MS/MSD data reported for sample -020 were prepared/analyzed six days before the sample was prepped, and is therefore unacceptable. Data for sample -020 was rejected. No field duplicates were identified.

VOCs. All required holding times were met. No method blank contamination was detected. Surrogate, LCS, and MS recoveries were within laboratory control limits with the following exception. The toluene-d8 recovery for sample -028 was greater than laboratory control limits. However, since this is a positive bias and all results were not detected, no qualifiers were necessary. No field duplicates were identified.

TPH Identification. All required holding times were met. No method blank contamination was detected. Surrogate recoveries were within laboratory control limits with the following exception. The 2-fluorobiphenol recovery for sample was not reported due to dilution. No qualifiers were necessary. Laboratory duplicate RPDs were acceptable. No field duplicates were identified.

PCBs. All required holding times were met. No method blank contamination was detected. Surrogate, LCS, and MS recoveries were within laboratory control limits. MS/MSD RPDs were acceptable. The LCS and MS/MSD data reported for sample -020 was prepared/analyzed seven before the sample was prepped, and is therefore unacceptable. Data for sample -020 was rejected. No field duplicates were identified.

PAHs. All required holding times were met with the exception of sample -020, which was analyzed 23 days after the sample was collected. All detected results were flagged "J", while nondetected results were flagged "UJ". No method blank contamination was detected. Surrogate, LCS, and MS recoveries were within laboratory control limits. MS/MSD RPDs were acceptable. No field duplicates were identified.

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. Surrogate, LCS, and MS recoveries were within laboratory control limits with the following exception. The surrogate recovery for sample -020 was not recoverable due to sample dilution. No qualification was necessary. Laboratory duplicate RPDs were acceptable. The LCS and MS data reported for samples -003, -011, -012, -013, -014, -020, -021, -023,

and -028 were prepared/analyzed between 1 and 2 weeks before the samples were prepped, and are therefore unacceptable. Data for these samples were rejected. No field duplicates were identified.

Appendix J: B-38 Area Characterization (March 2000)

Sample No. Prefix: 4876-000313
OAL ID No. L15469

Thirty-one soil samples were submitted to the laboratory, including some samples that were not analyzed in this set. The following analyses were performed on one or more samples:

- TPH as Diesel/Oil (NWTPH-Dx);
- Aromatic Hydrocarbons (BTEX, EPA Method 8020A); and
- PAHs (EPA Method 8270 SIM).

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. Surrogate recoveries were generally within laboratory control limits. Surrogate recoveries in some soil samples were above control limits due to high sample concentrations. Duplicate, LCS, and MS data reported for some samples were analyzed several days before the samples arrived in the laboratory. TPH data for samples -031, -036, -051, and -056 were rejected on this basis. The remaining duplicate and LCS data were within control limits. MS recoveries for samples -043, -044, -49, -053, -058, and -060 were outside of control limits, but the LCS data were acceptable, so no data were qualified on this basis. No field duplicates were identified.

BTEX. All required holding times were met. No method blank contamination was detected. LCS, surrogate, and MS recoveries were within laboratory control limits. Laboratory duplicate RPDs were acceptable. No field duplicates were identified.

PAHs. All required holding times were met. No method blank contamination was detected. LCS, surrogate, and MS/MSD recoveries were within laboratory control limits. Laboratory duplicate RPDs were acceptable. No field duplicates were identified.

Sample Prefix No. 4876-000316
OAL ID No. L15520

Thirty soil samples were submitted to the laboratory, including some samples that were not analyzed in this set. The following analyses were performed on one or more samples:

- TPH Identification (NWTPH-HCID);
- TPH as Diesel/Oil (NWTPH-Dx);
- BTEX, (EPA Method 8020A); and
- PAHs, (EPA Method 8270 SIM).

TPH Identification. All required holding times were met. No method blank contamination was detected. LCS and MS analyses are not required by NWTPH-HCID procedure. Surrogate recoveries were acceptable. The laboratory duplicate RPDs reported were extracted three days before the incumbent samples were extracted, and are therefore unacceptable. Samples -063 and -073 were flagged "J" based on the duplicate data and lack of suitable additional qualify control. No field duplicates were identified.

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. LCS and surrogate recoveries were within laboratory control limits. MS spiking levels were less than 20 percent of the native soil concentrations; therefore the control limits do not apply. Laboratory duplicate RPDs were acceptable. Duplicate, LCS, and MS data reported for -082 and -084 were prepared the day before the sample was prepared, and is therefore unacceptable. Data for -082 and -084 were rejected. No field duplicates were identified.

BTEX. All required holding times were met. No method blank contamination was detected. LCS, surrogate, and MS recoveries were within laboratory control limits. Laboratory duplicate RPDs were acceptable. No field duplicates were analyzed. Duplicate, LCS, and MS data reported for -075 and -079 were prepared/analyzed three days before the sample was prepared, and is therefore unacceptable. Data for -075 and -079 were rejected. No field duplicates were identified.

PAHs. All required holding times were met. No method blank contamination was detected. LCS/LCSD and surrogate recoveries were within laboratory control limits. Laboratory duplicate RPDs were acceptable. No field duplicates were analyzed. LCS/LCSD data reported for -075 and -

079 were prepared and analyzed five days before the sample was analyzed and is therefore unacceptable. Data for -075 and -079 were rejected. No field duplicates were identified.

Appendix K: Supplemental Site Characterization (September 2000)

Sample Prefix Nos. 5106-000919 & 5106-000920
NCA ID No. P009611

Forty-two soil samples were submitted to the laboratory, including some samples that were not analyzed in this set. The following analyses were performed on one or more samples:

- TPH as Diesel/Oil (NWTPH-Dx);
- PAHs (EPA Method 8270 SIM);
- Low-level VOCs (EPA Method 8260B);
- PCBs (EPA Method 8082);
- Priority Pollutant Metals (EPA 6000/7000 Series Methods); and
- Tributyltin (TBT, Krone method).

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. LCS and surrogate recoveries were within laboratory control limits. No MS analyses were performed. One of two laboratory duplicate RPDs was outside the laboratory control limits. No data were flagged as a result of the duplicate analyses. No field duplicates were identified.

PAHs. All required holding times were met. No method blank contamination was detected. LCS, surrogate, and MS/MSD recoveries were within laboratory control limits. Laboratory duplicate RPDs were acceptable. No field duplicates were identified.

VOCs. All required holding times were met. No method blank contamination was detected. LCS and surrogate recoveries were within laboratory control limits. MS recoveries for all analytes were below control limits; however, since LCS recoveries were acceptable, no data were qualified as a result of the MS values. Laboratory duplicate RPDs were acceptable. No field duplicates were identified.

PCBs. All required holding times were met with one exception. Sample – 023 was re-extracted 8 days after the holding time expired; however, given the persistent nature of the analyte, no data were qualified as a result of the expired holding time. No method blank contamination was detected. LCS, MS, and surrogate recoveries were within laboratory control limits. Laboratory duplicate RPD data were limited to LCS/LCSD and MS/MSD pairs and was acceptable. No field duplicates were identified.

Priority Pollutant Metals. All required holding times were met. No method blank contamination was detected. LCS and MS recoveries were within laboratory control limits with the following exceptions. MSD recovery for lead was slightly below control limits. Results were not qualified since the MS recovery was acceptable. Laboratory duplicate RPDs were acceptable. No field duplicates were identified.

TBT. Analysis was subcontracted to Sound Analytical Services, which reported using the PSEP protocols to perform the analysis. Established holding times could not be identified. No method blank contamination was detected. Surrogate recoveries were acceptable. No LCS analysis was performed. MS/MSD analyses were performed, but no established control limits were reported. Duplicate analysis RPD data were limited to the MS/MSD pair, and were acceptable. No field duplicates were identified.

Sample Prefix Nos. 5106-000919 & 5106-000920
NCA ID No. P009722

Thirty-six soil samples were submitted to the laboratory, including some samples that were not analyzed in this set. The following analyses were performed on one or more samples:

- TPH as Diesel/Oil (NWTPH-Dx);
- PAHs (EPA Method 8270 SIM);
- VOCs (EPA Method 8260B);
- Polychlorinated Biphenyls (PCBs, EPA Method 8082);
- Priority Pollutant Metals (EPA 6000/7000 Series Methods); and
- TCLP Lead (EPA 1311/6000/7000 Methods).

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. Surrogate and MS recoveries were within laboratory control limits. LCS analysis is not required by the method, and

none was performed. Laboratory duplicate RPDs were acceptable. No field duplicates were identified.

PAHs. All required holding times were met. No method blank contamination was detected. LCS and surrogate recoveries were within laboratory control limits. MS/MSD results were within control limits with one exception. 0100976MSD1 had a pyrene recovery above the laboratory control limits; however, since the bias was positive and the LCS results were accepted, no data were qualified as a result of the high pyrene recovery. Laboratory duplicate RPDs for -050 were outside control limits. Given the acceptability of the balance of the PAH QC data, no qualifiers were assigned. No field duplicates were identified.

VOCs. All required holding times were met. No method blank contamination was detected. LCS and surrogate recoveries were within laboratory control limits with one exception. The 4-BFB surrogate for -069 had a recovery above the upper control limit; however, since the bias was positive, no qualifiers were assigned. One MS/MSD set had recoveries for all analytes below control limits; however, since LCS recoveries were acceptable, no data were qualified as a result of the MS/MSD values. Laboratory duplicate RPD data were limited to LCS/LCSD and MS/MSD pairs and was acceptable. No field duplicates were identified.

PCBs. All required holding times were met with one exception. Sample -049 was re-extracted 11 days after the holding time expired; however, given the persistent nature of the analyte, no data wee qualified as a result of the expired holding time. No method blank contamination was detected. LCS, MS, and surrogate recoveries were within laboratory control limits. Laboratory duplicate RPDs were acceptable. No field duplicates were identified.

Priority Pollutant Metals. All required holding times were met. No method blank contamination was detected with one exception. The zinc reporting limit for one prep batch was elevated from 1 mg/kg to 2.5 mg/kg due to possible laboratory contamination of the sample or the extract. No data were qualified on this basis, as the only sample associated with blank contained zinc levels greater than 20 times the elevated reporting limit. LCS recoveries were within laboratory control limits. The MS mercury recovery for prep batch 0100945 was less than the lower control limit, and the mercury duplicate for the same batch was outside the control limits. Mercury values for -071, -072, and -077 were therefore flagged "J" as estimated. The MS antimony recovery for prep batch 010846 was less than the lower control limit; however a laboratory note stated "Multiple analyses indicate the percent recovery is outside the control limits due to a matrix effect." Because

the balance of the QC data for this batch was acceptable, the results were not qualified. The prep batch 0J29009 contained two matrix spikes. Arsenic and selenium recoveries for 0J2909-MS2 were below the lower control limits; however, the balance of the associated QC was acceptable, and no data were qualified. Laboratory duplicate data were otherwise acceptable. No field duplicates were identified.

TCLP Lead. All required holding times were met. No method blank contamination was reported. LCS and MS recoveries were acceptable. No duplicate data were reported.

Sample Prefix Nos. 5106-000925
NCA ID No. P009762

Six soil samples were submitted to the laboratory. The following analyses were performed on one or more samples:

- TPH as Diesel/Oil (NWTPH-Dx); and
- PAHs (EPA Method 8270 SIM);

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. Surrogate and LCS recoveries were within laboratory control limits. MS analysis is not required by the method, and none was performed. Laboratory duplicate RPDs were within the laboratory control limits. No field duplicates were identified.

PAHs. All required holding times were met. No method blank contamination was detected. LCS, MS, and surrogate recoveries were within laboratory control limits. Duplicate RPD data were acceptable. No field duplicates were identified.

Appendix L: Data Gap Investigation Soil Samples (October and November 2000)

Sample Prefix Nos. 5106-001026, 5106-001027, and 5106-001030
ESL ID No. 0010192

Thirty soil samples were submitted to the laboratory, including some samples that were not analyzed in this set. The following analyses were performed on one or more samples:

- TPH Identification (NWTPH-HCID);
- TPH as Diesel/Oil (NWTPH-Dx);

- BTEX, (EPA Method 8020A);
- PAHs, (EPA Method 8270 SIM); and
- Total Arsenic and Lead (EPA 6000/7000 Series Methods).

TPH Identification. All required holding times were met. No method blank contamination was detected. LCS and MS analyses are not required by NWTPH-HCID procedure, and were not performed. Surrogate recoveries were acceptable. Laboratory duplicate results were acceptable. No field duplicates were identified.

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. No LCS analysis was performed. Surrogate recoveries were within laboratory control limits. MS recoveries were within control limits. Laboratory duplicate RPDs were acceptable. No field duplicates were identified.

PAHs. All required holding times were met. No method blank contamination was detected. LCS and MS/MSD recoveries were within laboratory control limits. Laboratory duplicate RPDs were acceptable. Surrogate recoveries for -067, -068, -085, and -086 were elevated. Since the bias was positive, and all other associated QC was acceptable, no data were qualified based on surrogate recoveries. No field duplicates were identified.

Total Arsenic and Lead. All required holding times were met. No method blank contamination was detected. LCS and MS recoveries were within laboratory control limits. Laboratory duplicate RPDs were acceptable with the following exception. The RPD for the lead duplicate was 35.7 percent as compared to a control limit of 20 percent. Since the RPD for the lead MS/MSD pair was acceptable, no data were qualified. No field duplicates were identified.

Sample Prefix Nos. 5106-001024 & 5106-001025
NCA ID No. P010845

Fifty-five soil samples were submitted to the laboratory, including some samples that were not analyzed in this set. The following analyses were performed on one or more samples:

- TPH as Diesel/Oil (NWTPH-Dx);
- PAHs (EPA Method 8270 SIM); and
- VOCs (EPA Method 8260B).

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. Surrogate and LCS recoveries were within laboratory control limits. MS analysis is not required by the method, and none was performed. Laboratory duplicate RPDs were within the laboratory control limits. The chain of custody specified that sample -047 be performed in duplicate; however, no duplicate analysis was reported in this sample set. No field duplicates were identified.

PAHs. All required holding times were met. No method blank contamination was detected. LCS and surrogate recoveries were within laboratory control limits. MS/MSD results were not useable, as analyte concentrations in the native sample were greater than four times the spiking levels. Laboratory duplicate data were acceptable. No field duplicates were identified.

VOCs. All required holding times were met. No method blank contamination was detected. LCS, MS, and surrogate recoveries were within laboratory control limits. Laboratory duplicate RPD data were limited to the MS/MSD pair, and were acceptable. No field duplicates were identified.

Sample Prefix No. 5106-0011106
ESL ID No. 0011030

Ten soil samples were submitted to the laboratory, including one sample that was not analyzed in this set. The following analyses were performed on one or more samples:

- TPH as Diesel/Oil (NWTPH-Dx);
- PAHs, (EPA Method 8270 SIM); and
- Total Arsenic and Lead (EPA 6000/7000 Series Methods).

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. LCS recovery was 69.2 percent compared to the lower control limit of 70 percent. Because the MS recoveries were within control limits, no data were qualified. Surrogate recoveries were within laboratory control limits. Laboratory duplicate RPDs were acceptable. No field duplicates were identified.

PAHs. All required holding times were met. No method blank contamination was detected. Surrogate, LCS and MS/MSD recoveries were within laboratory control limits. Laboratory duplicate RPDs were acceptable. No field duplicates were identified.

Total Arsenic and Lead. All required holding times were met. No method blank contamination was detected. LCS and MS recoveries were within laboratory control limits. Laboratory duplicate RPDs were acceptable with the following exception. The RPD for the lead duplicate was 24.6 percent as compared to a control limit of 20 percent. Since the RPD for the lead MS/MSD pair was acceptable, no data were qualified. No field duplicates were identified.

Appendix M: Baseline Groundwater (February and March 2000)

Sample Prefix No. 4876-000229
OAL ID No.L15336

Nine water samples were submitted to the laboratory. The following analyses were performed on one or more samples:

- PAHs (EPA Method 8270 SIM);
- Full List Semivolatile Organic Compounds (Semi-VOAs, EPA Method 8270);
- VOCs (EPA Method 8260); and
- Priority Pollutant Dissolved Metals (Dissolved Metals, EPA 200/6000/7000 Series Methods).

PAHs. All required holding times were met. No method blank contamination was detected. Surrogate and LCS recoveries were within laboratory control limits. No MS data were reported. Laboratory duplicate RPDs were acceptable. No field duplicates were identified.

Semi-VOAs. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCSD recoveries were within control limits. Laboratory duplicate RPD data were limited to the LCS/LCSD pair and were acceptable. No field duplicates were identified.

VOCs. All required holding times were met. No method blank contamination was detected. Surrogate, LCS, and MS/MSD recoveries were within control limits. Laboratory duplicates RPD data were limited to the MS/MSD pair and were acceptable. No field duplicates were identified.

Dissolved Metals. All required holding times were met. No method blank contamination was detected. LCS and MS recoveries were within laboratory control limits. Laboratory duplicate RPDs were acceptable. No field duplicates were identified.

Sample Prefix No. 4876-000313
OAL ID No.L15469

Two water samples were submitted to the laboratory. The following analyses were performed on one or more samples:

- PAHS (EPA Method 8270 SIM);
- Semi-VOAs (EPA 8270); and
- BTEX (EPA Method 8020A).

PAHs. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCSD recoveries were within laboratory control limits. No MS data were reported. Laboratory duplicate was limited to the LCS/LCSD pair, and the RPDs were acceptable. No field duplicates were analyzed.

Semi-VOAs. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCSD recoveries were within control limits. No MS data were reported. Laboratory duplicate RPD data were limited to the LCS/LCSD pair and were acceptable.

BTEX. All required holding times were met. No method blank contamination was detected. Surrogate recoveries were acceptable. LCS, MS, and duplicate data were reported before the sample set arrived at the laboratory. All BTEX data were therefore rejected.

Sample Prefix No. 4876-000316
OAL ID No.L15520

Four water samples were submitted to the laboratory. The following analyses were performed on one or more samples:

- PAHS (EPA Method 8270 SIM); and
- BTEXs (EPA Method 8020A).

PAHs. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCD recoveries were within laboratory control limits. No MS data were reported. Laboratory

duplicate RPD data were limited to the LCS/LCSD pair and were acceptable. No field duplicates were identified.

BTEX. All required holding times were met. No method blank contamination was detected. Surrogate recoveries were acceptable. Laboratory duplicate data were acceptable. LCS and MS data were reported before the sample set arrived at the laboratory. All BTEX data were therefore rejected.

Appendix O: Supplemental Site Characterization Groundwater (September 2000)

Sample Prefix Nos. 5106-000922 & 5106-000925
NCA ID No. P009764

Seven water samples were submitted to the laboratory. The following analyses were performed on one or more samples:

- PAHs (EPA Method 8270 SIM);
- VOCs (EPA Method 8260B);
- Priority Pollutant Metals (EPA 6000/7000 Series Methods); and
- Bis(2-Ethylhexyl)phthalate (DEHP, EPA Method 8270).

PAHs. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCSD recoveries were within laboratory control limits. Laboratory duplicate RPD data were limited to the LCS/LCSD pair and were acceptable. No field duplicates were identified.

VOCs. All required holding times were met. No method blank contamination was detected. Surrogate, LCS/LCSD, and MS/MSD recoveries were within laboratory control limits. Laboratory duplicate RPD data were limited to LCS/LCSD and MS/MSD pairs and were acceptable. No field duplicates were identified.

Priority Pollutant Metals. All required holding times were met. No method blank contamination was detected. LCS recoveries were within laboratory control limits. There were two matrix spikes associated with this prep batch. The first spiked sample was from this sample set, and all recoveries were within control limits except for copper, which had a recovery of 62 percent as compared to the lower control limit of 75 percent. However, the LCS recovery for copper was acceptable. The second matrix spike was not from this sample set, and generally had poor recoveries. No data were qualified

based on MS recoveries. Laboratory duplicate results were acceptable. No field duplicates were identified.

DEHP. All required holding times were met. No method blank contamination was reported. Surrogate and LCS/LCSD recoveries were acceptable. Only LCS/LCSD duplicate data were reported and were acceptable. No field duplicates were identified.

Appendix P: Data Gap Investigation Groundwater (October and November 2000)

Sample Prefix Nos. 5106-001026, 5106-001027, 5106-001030, and 5106-001024
ESL ID No. 0010191

Eight water samples were submitted to the laboratory. The following analyses were performed on one or more samples:

- TPH as Diesel/Oil (NWTPH-Dx);
- PAHs (EPA Method 8270 SIM);
- VOCs (EPA Method 8260B); and
- Bis(2-Ethylhexyl)phthalate (DEHP, EPA Method 8270).

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. Surrogate, LCS/LCSD, and MS recoveries were within laboratory control limits. Laboratory duplicate RPD data were limited to the LCS/LCSD pair and were acceptable.

PAHs. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCSD recoveries were within laboratory control limits. Laboratory duplicate RPD data were acceptable. No field duplicates were identified.

VOCs. All required holding times were met. No method blank contamination was detected. Sample -100 was identified as "TB" on the chain of custody, and could possibly be a trip blank; however, there was nothing in the data to confirm its status. Surrogate and MS/MSD recoveries were within laboratory control limits. Laboratory duplicate RPD data were limited to the MS/MSD pair and were acceptable. No field duplicates were identified.

DEHP. All required holding times were met. No method blank contamination was reported. Surrogate and LCS/LCSD recoveries were acceptable. Laboratory duplicate RPD data were limited to the LCS/LCSD pair and were acceptable. No field duplicates were identified.

Data Prefix No. 5106-001024
NCA Lab ID No. P010847

Three water samples were submitted to the laboratory. The following analyses were performed on one or more samples:

- TPH as Diesel/Oil (NWTPH-Dx);
- PAHs (EPA Method 8270 SIM); and
- VOCs (EPA Method 8260B).

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. Surrogate, LCS/LCSD, and MS recoveries were within laboratory control limits. Laboratory duplicate RPD data were limited to the LCS/LCSD pair and were acceptable. No field duplicates were identified.

PAHs. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCSD recoveries were within laboratory control limits. Laboratory duplicate RPD data were limited to the LCS/LCSD data pair and were acceptable. No field duplicates were identified.

VOCs. All required holding times were met. No method blank contamination was detected. Sample -100 was identified as "TB" on the chain-of-custody, and could possibly be a trip blank; however, there was nothing in the data to confirm its status. There are no data in the sample set corresponding to this sample. Surrogate and LCS/LCSD recoveries were within laboratory control limits. There were no MS data provided. Laboratory duplicate RPD data were limited to the LCS/LCSD pair and were acceptable. No field duplicates were identified.

Data Prefix No. 5106-001025
NCA Lab ID No. P010848

One water samples was submitted to the laboratory. The following analyses were performed:

- TPH as Diesel/Oil (NWTPH-Dx);

- PAHs (EPA Method 8270 SIM); and
- DEHP (EPA Method 8270C).

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCSD recoveries were within laboratory control limits. MS data were acceptable. Laboratory duplicate data were acceptable. No field duplicates were identified.

PAHs. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCSD recoveries were within laboratory control limits. No MS data were provided. Laboratory duplicate RPD data were acceptable. No field duplicates were identified.

DEHP. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCSD recoveries were within laboratory control limits. No MS data were provided. Laboratory duplicate RPD data were acceptable. No field duplicates were identified.

The MS/MSD data reported for -020 was prepared/analyzed six days before the sample was prepped, and is therefore unacceptable. Data for -020 was rejected.

Sample Prefix Nos. 5106-001106
ESL ID No. 0011031

Two water samples were submitted to the laboratory. The following analyses were performed on one or more samples:

- TPH as Diesel/Oil (NWTPH-Dx);
- PAHs (EPA Method 8270 SIM); and
- BNA SVOCs (EPA Method 8270C).

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. Surrogate, LCS, and MS recoveries were within laboratory control limits. Laboratory duplicate RPD data was limited to the LCS/LCSD pair, and was acceptable.

PAHs. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCSD recoveries were within laboratory control limits. Laboratory duplicate RPD data was acceptable. No field duplicates were identified.

BNA SVOCs. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCSD recoveries were within laboratory control limits. Laboratory duplicate RPD data was acceptable. No field duplicates were identified.

MONITORING WELL INSTALLATION AND GROUNDWATER SAMPLING

Appendix D: Laboratory Results and Chain-of-Custody Documentation: Soil Sample

NCA ID No. P1H0861

One soil sample was submitted to the laboratory. The following analyses were performed:

- TPH as Diesel/Oil (NWTPH-Dx);
- Total Metals (EPA 6000/7000 Series Methods);
- Volatile Organic Compounds (VOCs, EPA Method 8260A); and
- PAHs (EPA Method 8270M-SIM).

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. Surrogate and LCS recoveries were within laboratory control limits with the following exception. The surrogate recovery for duplicate sample (1091079-DUP) was not recoverable due to sample dilution. No qualification was necessary. Laboratory duplicate RPDs were acceptable.

Total Metals. All required holding times were met. No method blank contamination was detected. LCS and MS recoveries were within laboratory control limits with the following exceptions. Antimony MS recoveries of 51.1 and 46.9 percent were less than control limits (75 to 125 percent); however, the laboratory notes state that these recoveries were outside of control limits due to sample dilution. Therefore, no qualification was necessary. The laboratory duplicate RPDs for antimony (44.4 percent), beryllium (43.8 percent), silver (40.3 percent), and thallium (62.9 percent) were greater than the control limit of 40 percent. However, since the original and duplicate sample results for these four metals were nondetect, the RPD is not applicable and no qualification was necessary.

VOCs. All required holding times were met. No method blank contamination was detected. Surrogate, LCS, and MS recoveries were within laboratory control limits. MS/MSD RPDs were acceptable.

PAHs. All required holding times were met. No method blank contamination was detected. Surrogate, LCS, and MS recoveries were within laboratory control limits with the following exception. The benzo(a)pyrene and pyrene MS spikes were not recoverable and the MS/MSD RPD was greater than control limits due to a non-homogeneous sample matrix according to the laboratory. Additionally, the pyrene source result was more than four times greater than the pyrene spike level indicating that the percent recovery for pyrene is not applicable. Because the MS/MSD sample was from a separate sample batch, the remaining quality control samples were acceptable, and benzo(a)pyrene was not detected in the site sample, no qualification was necessary.

Appendix E: Laboratory Results and Chain-of-Custody Documentation: September/October 2001 Groundwater Monitoring Samples

NCA ID No. P1J0098

Four groundwater samples were submitted to the laboratory. The following analyses were performed on one or more of the samples:

- TPH as Diesel/Oil (NWTPH-Dx);
- Total and Dissolved Metals (EPA 6000/7000 Series Methods);
- VOCs (EPA Method 8260A);
- SVOCs (EPA Method 8270C); and
- PAHs (EPA Method 8270M-SIM).

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCS Dup recoveries were within laboratory control limits. The LCS/LCS Dup RPDs were within laboratory control limits.

Total and Dissolved Metals. All required holding times were met. No method blank contamination was detected. LCS and MS recoveries and duplicate RPDs were within laboratory control limits with the following exceptions. The dissolved metals duplicate RPDs for copper and lead exceeded the RPD limit of 20 percent. However, the original and duplicate sample results for both metals were nondetect indicating that the RPD criterion is not applicable and that no qualification is necessary.

VOCs. All required holding times were met. No method blank contamination was detected. Surrogate, LCS, and MS/MSD recoveries were within laboratory control limits. MS/MSD RPDs were acceptable.

SVOCs. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCS Dup recoveries were within laboratory control limits. LCS/LCS Dup RPDs were acceptable.

PAHs. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCS Dup recoveries were within laboratory control limits. LCS/LCS Dup RPDs were acceptable.

NCA ID No. P1J0097

Five groundwater samples were submitted to the laboratory. The following analyses were performed on one or more of the samples:

- TPH as Diesel/Oil (NWTPH-Dx);
- Total and Dissolved Metals (EPA 6000/7000 Series Methods);
- VOCs (EPA Method 8260A);
- SVOCs (EPA Method 8270C); and
- PAHs (EPA Method 8270M-SIM).

TPH as Diesel/Oil. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCS Dup recoveries were within laboratory control limits. The LCS/LCS Dup RPDs were within laboratory control limits. The laboratory flagged the concentrations of diesel-range organics in samples 5106-011001-108 (MW-1) and 5106-01101-109 (MW-1 Dup) to indicate that the detected hydrocarbons have non-petroleum peaks suggesting the presence of biogenic interference. The results suggest the detected diesel-range organics may be an overestimate, if present, in the sample.

Total and Dissolved Metals. All required holding times were met. No method blank contamination was detected. LCS and MS recoveries and duplicate RPDs were within laboratory control limits. The dissolved metals duplicate RPDs for copper and lead exceeded the RPD limit of 20 percent. However, the original and duplicate sample results for both metals were nondetect indicating that the RPD criterion is not applicable and that no qualification is necessary.

VOCs. All required holding times were met. No method blank contamination was detected. Surrogate, LCS, and MS/MSD recoveries were within laboratory control limits. MS/MSD RPDs were acceptable.

SVOCs. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCS Dup recoveries were within laboratory control limits. LCS/LCS Dup RPDs were acceptable.

PAHs. All required holding times were met. No method blank contamination was detected. Surrogate and LCS/LCS Dup recoveries were within laboratory control limits with the following exceptions. The laboratory flagged the surrogate recoveries for sample MW-1 Dup indicating that the surrogate recoveries exceeded control limits, the laboratory suspected a double spike of the surrogate solution during extraction, and that actual surrogate recoveries were believed to be one-half the reported values. The surrogate recoveries for sample MW-1 were within laboratory control limits supporting the laboratories claim that the surrogate solution was double spiked. Additionally, since no analytes were detected in sample MW-1 Dup, no qualification was necessary.

Field Groundwater Duplicate Samples (MW-1/MW-1 Dup). The precision requirements for analyte detected in samples MW-1 and MW-1 Dup were met. All analytes detected were detected at concentrations less than five times their respective reporting limits. Therefore, a control limit of plus or minus the reporting limit was used to evaluate precision for these analytes.

Equipment Blank. VOCs and bis(2-ethylhexyl)phthalate were not detected above method detection limits in sample 5106-011001-110 (Equipment Blank).